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DOES CHAULMOOGRA TREATMENT INFLUENCE THE SHIFTING OF SEROLOGIC FINDINGS IN LEPERS AS OBTAINED BY THE WASSERMANN, KAHN, AND VERNES REACTIONS?

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SIX TEXT FIGURES

INTRODUCTION

A great amount of evidence gathered by investigators indicates that sera of lepers frequently give positive Wassermann and Kahn reactions. In the Philippines, the Vernes test in leprosy has not been studied. It was, therefore, considered advisable to study the Philippine material and to arrange parallel tests with the Vernes on the one side and the Wassermann and Kahn tests on the other.

The Vernes test being a quantitative reaction, and the reading being made with a photometer, the information as to the amount of "reagin" present in the serum of lepers will become more clearly evident by this method.

It has been claimed by a majority of authors that strong positive Wassermann and Kahn reactions in lepers have the same significance as in nonlepers. This claim very likely is due to the observation made on serologic curves in lepers who had not received antisyphilitic drugs or who had not been repeatedly tested for a sufficiently long time by careful serologic, quantitative methods. Only recently B. T. Badger,[1] of the leper station

[1] Banger, L. F., Public Health Reports, issued by the U. S. Public Health Service 46 (April 24, 1931) No. 17.

in Hawaii, performed repeated examinations on a small group of lepers, using the quantitative Kahn test. He showed that variations in units of reagin may occur in the sera of lepers treated exclusively by chaulmoogra preparations. Therefore, these lepers received no antisyphilitic drugs whatsoever. It was our purpose to study in these investigations the effect upon the degree of serologic reaction of chaulmoogra treatment. For this purpose we have used the Vernes reaction, comparing the results obtained thereby with those shown by the Wassermann and the Kahn methods. It was hoped that by this arrangement such effect of chaulmoogra treatment as may be exerted upon the serologic reaction would be more evident and earlier perceptible by the more sensitive quantitative Vernes reaction than by the usual Wassermann and Kahn methods.

Whether or not the "reagin" present in the serum of lepers, as detectible by positive Wassermann, Vernes, and Kahn tests, is due to the infection by *M. lepræ* or caused by latent treponematous infection, has been considered in this investigation.

In lepers, in the Philippines as in any tropical country, who show positive Vernes, Wassermann, and Kahn reactions, we cannot exclude by clinical means or by history the possibility of a previous contamination by syphilis or particularly by yaws.

All the evidence gathered from clinical patients is burdened by the objection that syphilis and yaws may be, and no doubt are, just as prevalent among lepers as among nonlepers. However, it has been found that the serologic reactions in lepers decreased in degree when chaulmoogra treatment had been continued for some time in the same lepers. The chaulmoogra oil being considered specific for leprosy, these findings may lead to the conclusion that positive serologic reactions in lepers are due to the infection by *M. lepræ*. On the other hand, there is some evidence, both clinical and experimental, that militates against this explanation. To start with, there appears to be no quantitative relation between the extent of intensity of the leprous lesions in untreated lepers and the degree of the serologic reactions. Furthermore, in monkeys in which typical leprous lesions were produced by superinoculations with leprous material the serologic reaction remained negative (Wassermann and Kahn).[2]

Any further investigation along the above-mentioned lines will not rid the evidence of the objection that the patient may have

[2] Schöbl, Otto, Eloy V. Pineda, and Isao Miyao, Philip. Journ. Sci. 41 (1930) 233.

syphilis or yaws. We have attempted, therefore, to approach the problem experimentally from another angle. It appeared to us that the missing link in the chain of evidence presented in the literature, is the question whether or not chaulmoogra treatment affects the serologic reactions caused by treponematous infections.

Through the courtesy of Dr. Otto Schöbl, formerly of the Bureau of Science, five Philippine monkeys that had been inoculated by him years ago with syphilis and yaws were placed at my disposal. These animals still showed at the time of this experiment strongly positive Vernes, Wassermann, and Kahn reactions. Unfortunately four of the monkeys died during the experiment and only one survived. The monkey that survived received no antisyphilitic treatment whatsoever, and for the present experiment this monkey received a few injections of pure chaulmoogra oil. The effect of chaulmoogra treatment upon the positive Vernes, Wassermann, and Kahn reactions caused by syphilis and yaws in this monkey is shown in this paper.

TECHNIC

During this investigation the Wassermann test was performed by Dr. Onofre Garcia, of the biologic division, Bureau of Science. The technic for the Wassermann test was the same as that described by Schöbl and the writer;[3] that is, guinea-pig's complement, antimonkey hæmolytic system, and alcoholic and cholesterinized antigens. The results of the Wassermann test are expressed as follows: + + + + = 100 per cent hæmolysis, + + + = 75 per cent, + + = 25 per cent, + = 10 per cent, ± = 5 per cent, — = no hæmolysis.

The Kahn test and the Vernes test were performed by the writer. For the Kahn test, the technic followed was that described by Kahn.[4] Our antigen was prepared from bacto-beef heart and its sensitiveness complied with the requirements of an antigen control obtained directly from Kahn's laboratory. Our final results in the Kahn test are expressed as an average of the reactions in three tubes following the advice given by Kahn in his book.

The results of the Vernes test in our table are given in figures that represent the exact figures of the photometric readings of each sample of blood.

[3] Philip. Journ. Sci. § B 12 (1917) 249.
[4] The Kahn Test. A Practical Guide (1928).

The Vernes reaction was performed by following exactly Vernes's technic,[5] which the author of this paper learned in the laboratory of Professor Vernes at the Prophylactic Institute of Paris.

MATERIAL INVESTIGATED

Samples of blood obtained from eighty-four lepers were examined, and the results are here presented. All the patients were Filipinos except two Chinese and one native of Guam. There were fifty-seven males and twenty-seven females. The ages ranged from 6 to 67 years.

Forty-six of these patients received no treatment with injections of chaulmoogra preparations up to the time of this experiment.

There were thirty-three lepers who received previously chaulmoogra injections and only five patients who received besides chaulmoogra a certain amount of neosalvarsan.

In the total of eighty-four cases there were sixty-nine considered as active lepers showing both clinical and bacteriological positive findings of leprosy. In five cases the clinical manifestations of the disease were evident, but the lepra bacilli, though present in the lesions of these patients at the beginning of chaulmoogra treatment, disappeared during continuous treatment.

In ten cases the clinical signs of leprosy were clear, but these patients were found persistently negative for lepra bacilli before and after treatment. The patients of this last group were considered clinical lepers.

GROUP OF UNTREATED LEPERS

In this group of untreated lepers, composed of forty-six cases, the Vernes, Wassermann, and Kahn reactions were positive in twenty-five, giving a positive percentage of 54.3. In the rest, twenty-one cases, the three tests were all negative. There were seventeen males and eight females; the male to female ratio is 2.1:1. In this group all the cases were positive both clinically and bacteriologically except two cases (4 and 6, Table 1); these were considered as clinical lepers.

Among the twenty-five untreated lepers, the results of positive Vernes, Wassermann, and Kahn tests, as shown in Table 1, agree

[5] Travaux et publications de l'Institut Prophylactique. Fasc. 2, Maloine ed. (1923).

with each other in most respects. In case 5 the Wassermann reaction was 2 plus, while the Vernes and Kahn were negative. In cases 9 and 10 the Wassermann was negative and 1 plus, respectively, while the Vernes and Kahn were strongly positive. In case 13 the Vernes test showed a positive result of 10, while the Wassermann and Kahn tests were negative.

TABLE 1.—*Comparative results in the blood of 25 untreated lepers showing positive Vernes, Wassermann, or Kahn tests.*

No.	Name.	Nationality.	Sex.	Age.	Type.	Lepra bacillus.	Test.		
							Vernes.	Wassermann.	Kahn.
				Yrs.					
1	C. M.	Guam	F	44	M	+	10	----------	++++
2	C. L.	Chinese	M	24	M	+	132	++++	+++
3	N. B.	Filipino	M	54	C	+	0	±	—
4	F. C.	----do----------	M	51	N	[a]—	20	++	++++
5	C. C.	----do----------	M	21	M	+	0	++	—
6	T. S.	----do----------	M	15	M	[a]—	3	++	—
7	G. P.	----do----------	M	21	M	+	4	+	—
8	M. L.	----do----------	F	15	C	+	1	++	—
9	G. G.	----do----------	F	30	M	+	23	—	++++
10	M. M.	----do----------	M	28	M	+	21	+	++++
11	J. M.	----do----------	M	37	M	+	0	+	—
12	L. B.	----do----------	M	15	M	+	1	+	—
13	G. C.	----do----------	M	21	M	+	10	—	—
14	F. G.	----do----------	F	13	M	+	0	+	—
15	N. S.	----do----------	F	19	M	+	0	+	—
16	H. V.	----do----------	F	18	M	+	131	+++	++++
17	D. A.	----do----------	M	35	M	+	113	++	++++
18	C. C.	----do----------	M	47	M	+	121	++	+++
19	S. A.	----do----------	M	21	M	+	0	±	—
20	A. V.	----do----------	M	30	M	+	57	++	+++
21	L. M.	----do----------	F	23	M	+	1	±	—
22	F. B.	----do----------	F	50	M	+	39	++	++
23	P. U.	----do----------	M	57	M	+	53	++	++
24	J. V.	----do----------	M	28	M	+	8	+	++
25	A. D.	----do----------	M	6	C	+	73	++	+ +++

[a] A clinical leper.

GROUP OF LEPERS TREATED WITH CHAULMOOGRA

This group consists of thirty-three cases. In ten of these cases the Vernes, Wassermann, and Kahn tests were found positive and in twenty-three negative. The positive percentage in this treated group was only 30.3. These positive cases were six males and four females, a ratio of 1.5: 1.

All these cases were clinically and bacteriologically positive except Nos. 9 and 10, Table 2, which were considered as clinical

lepers. In the group of ten treated lepers, shown in Table 2, with positive Vernes, Wassermann, and Kahn reactions, the general agreement of the three tests is also evident. In cases 1 and 3 the Wassermann was 2 plus while the Vernes and Kahn were negative. In case 5 the Vernes test showed a strength of 15 and the Wassermann and Kahn tests were only ±. In case 7 the Vernes test was 4 and the Wassermann and Kahn tests were negative.

TABLE 2.—*The results of the positive Vernes, Wassermann, or Kahn test in ten lepers treated with chaulmoogra.*

No.	Name.	Nationality.	Sex.	Age.	Type.	Lepra bacilli.	Test.		
							Vernes.	Wassermann.	Kahn.
				Yrs.					
1	C. C.	Filipino	M	21	M	+	0	++	—
2	R. D.	do	M	19	M	+	5	++	—
3	E. R.	do	F	24	M	+	0	++	—
4	C. G.	do	F	23	M	+	25	++	++++
5	M. B.	do	F	14	M	+	15	±	±
6	J. S.	do	F	14	M	+	0	+	—
7	J. C.	do	M	35	M	+	4	—	—
8	J. Q.	do	M	40	M	+	1	±	—
9	D. R.	do	M	67	C	*—	0	±	—
10	F. M.	do	M	53	C	*—	6	±	±

* A clinical leper.

GROUP OF LEPERS TREATED WITH CHAULMOOGRA AND NEOSALVARSAN

Only five cases are included in this group; four males and one female (Table 3).

Patient 1 received 45 cc of chaulmoogra during a period of two months. Blood tests at the end of this period (November 4, 1931) showed: Vernes reaction, 23; Wassermann reaction, + +; Kahn reaction, + + + +.

After these blood examinations, the patient received no treatment for one month and then new injections of chaulmoogra were given up to January, 1932, the patient receiving in all 6 cc of the drug. Another blood examination by the Vernes, Wassermann, and Kahn tests was made January 19, 1932, and the results showed that the Kahn test remained unchanged; the Vernes decreased from 23 to 17, and the Wassermann reaction decreased also, even though slightly (+). The condition of the leprotic lesions on January 19, 1932, revealed slight improvement.

TABLE 3.—*The results of Vernes, Wassermann, and Kahn tests in five lepers treated with chaulmoogra and neosalvarsan.*

No.	Name.	Nationality.	Sex.	Age.	Type of lesion.	Lepra bacilli.	First blood examination.
				Yrs.			
1	P. A.	Filipino	M	22	C	+	November 4, 1931.
2	C. A.	do	F	38	M	+	November 4, 1931.
3	P. B.		M	67	M	+	November 4, 1931.
4	P. V.	Filipino	M	44	M	+	November 4, 1931.
5	J. M.	do	M	54	M	+	November 4, 1931.

No.	Name.	Nationality.	Test.			Drug received up to the time of blood examination.
			Vernes.	Wassermann.	Kahn.	
1	P. A.	Filipino	23	++	++++	45 cc chaulmoogra.
2	C. A.	do	20	+	++++	13 injections of bismugenol. 0.15 g neosalvarsan.
3	P. B.		0	—	—	Neosalvarsan: 0.15; 0.30; 0.60
4	P. V.	Filipino	1	—	—	Neosalvarsan: 0.15, 0.60; 0.30, 0.75; 0.45, 0.90
5	J. M.	do	0	—	—	Neosalvarsan: 0.15, 0.45; 0.30, 0.60; 0.40, 0.90

Three months later beginning April 8, 1932, the patient was given three injections of neosalvarsan (0.30, 0.45, and 0.60 g). The Vernes test dropped to negative on April 29, 1932, and later the Kahn test on June 17, 1932; the Wassermann reaction however remained unchanged, that is, 1 plus.

After neosalvarsan treatment the macular skin lesions improved markedly up to November 28, 1932. At this date the Vernes test was negative, the Wassermann 1 plus, and the Kahn test increased again up to 3 plus (see serologic curve case 1).

Patient 2 was considered as a suspicious leper by the clinical appearance; the bacteriological examinations of lesions were always negative for lepra bacilli. After admission to the hospital, however, microscopical examination of the lesions in two instances revealed lepra bacilli.

Soon after this patient was admitted, his blood was examined in the laboratory of the hospital by the Wassermann and Kahn tests and showed strongly positive reactions.

This patient received no injection of chaulmoogra whatsoever but only antitreponematous treatment (first thirteen injections of bismugenol and later 0.15 g of neosalvarsan), during her stay in the hospital.

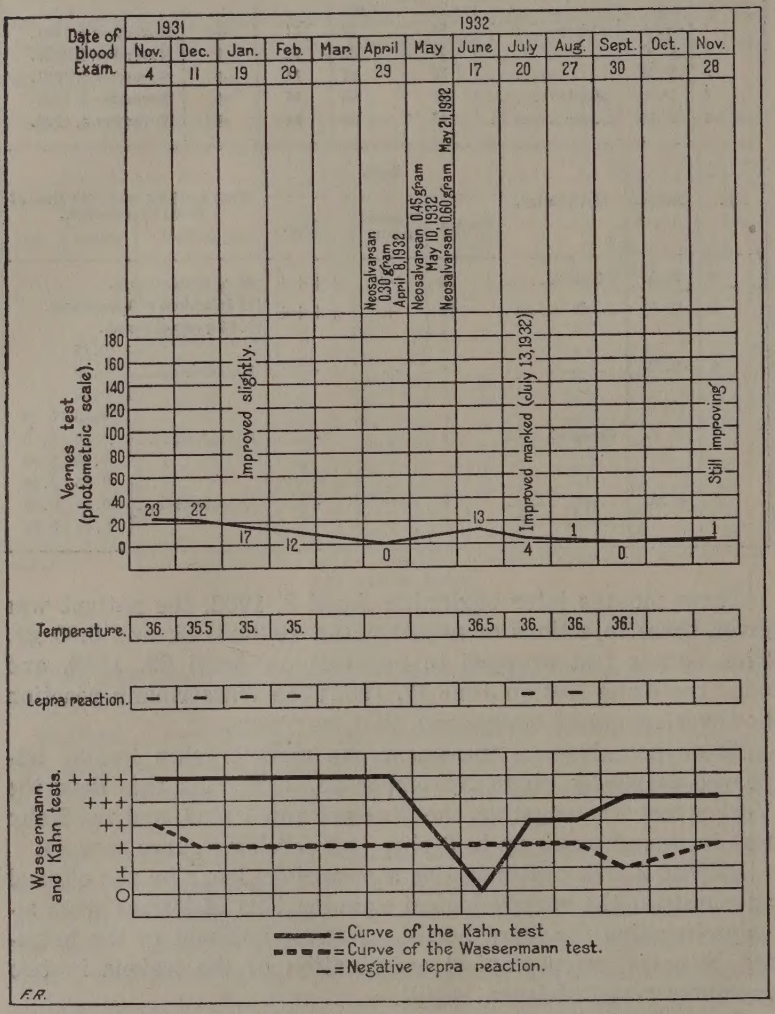
Date of blood Exam.
1931
1932
Nov. Dec. Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov.
4 11 19 29 29 17 20 27 30 28
Neosalvarsan 0.30 gram April 9, 1932
Neosalvarsan 0.45 gram May 10, 1932
Neosalvarsan 0.60 gram May 21, 1932
Vernes test (photometric scale).
Improved slightly.
Improved marked (July 13, 1932)
Still improving
23 22 17 12 0 13 4 1 0 1
Temperature.
36. 35.5 35. 35. 36.5 36. 36. 36.1
Lepra reaction.
Wassermann and Kahn tests.
= Curve of the Kahn test
= Curve of the Wassermann test.
= Negative lepra reaction.
F.R.

FIG. 1. Leper treated with chaulmoogra and neosalvarsan. Case 1.

Two months after the neosalvarsan injection blood examinations (case 2) showed the following: Vernes reaction, 20; Wassermann reaction, + +; Kahn reaction, + + + +.

Repeated serologic examinations were performed later during a period of three months and the results of these are given in the same table. The results indicate that the Vernes reaction

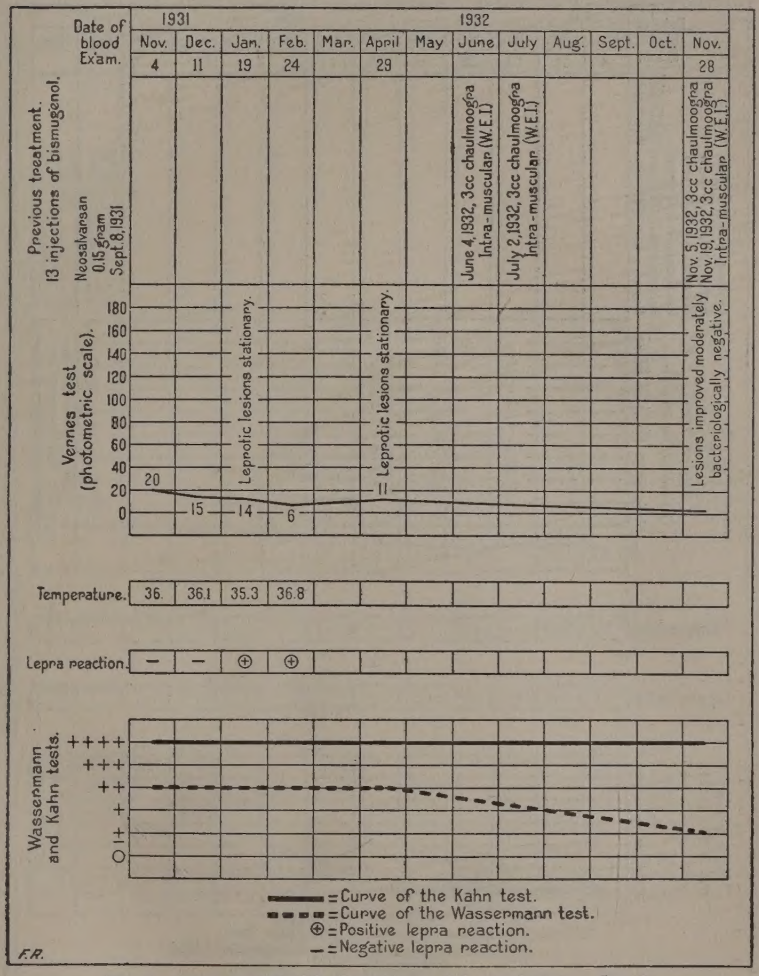
Date of blood Exam.
1931
1932
Nov. Dec. Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov.
4 11 19 24 29 28
Previous treatment. 13 injections of bismugenol. Neosalvarsan 0.15 gram Sept. 8, 1931
June 4, 1932, 3cc chaulmoogra Intra-muscular (W.E.I.)
July 2, 1932, 3cc chaulmoogra Intra-muscular (W.E.I.)
Nov. 5, 1932, 3cc chaulmoogra Nov. 19, 1932, 3cc chaulmoogra Intra-muscular (W.E.I.)
Vernes test (photometric scale).
180 160 140 120 100 80 60 40 20 0
Leprotic lesions stationary.
Leprotic lesions stationary.
Lesions improved moderately bacteriologically negative.
20 15 14 6 11
Temperature.
36. 36.1 35.3 36.8
Lepra reaction.
− − ⊕ ⊕
Wassermann and Kahn tests.
++++ +++ ++ + ± ○
= Curve of the Kahn test.
= Curve of the Wassermann test.
⊕ = Positive lepra reaction.
− = Negative lepra reaction.
F.R.

FIG. 2. Leper treated with chaulmoogra and neosalvarsan. Case 2.

decreased only slightly, but the Wassermann and Kahn reactions remained unchanged.

The leprotic lesions of this patient for the present are apparently stationary, but the lepra bacilli in the same lesions disappeared in spite of the absence of specific treatment for lep-

rosy. On account of the little change observed in the serologic curve of this patient from November 4, 1931, to April 29, 1932, and practically no improvement of the leprotic lesions, this pa-

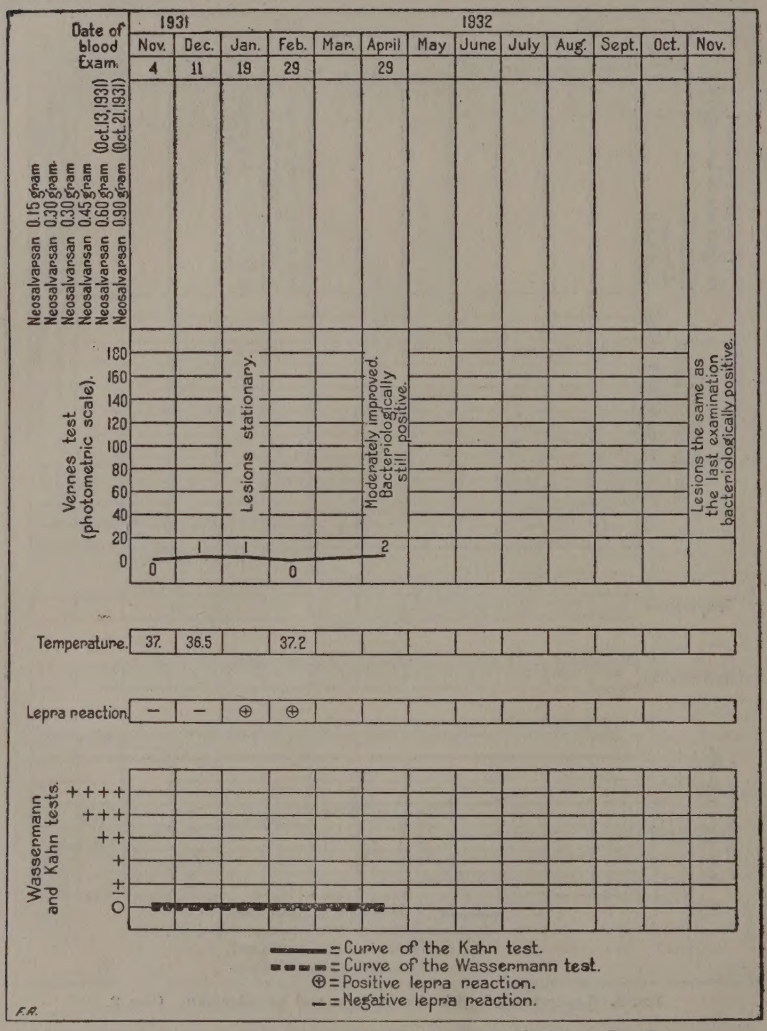
Date of blood Exam.
1931
1932
Nov. Dec. Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov.
4 11 19 29 29
Neosalvarsan 0.15 gram (Oct.19,1931)
Neosalvarsan 0.30 gram
Neosalvarsan 0.30 gram
Neosalvarsan 0.45 gram (Oct.21,1931)
Neosalvarsan 0.60 gram
Neosalvarsan 0.90 gram
Vernes test (photometric scale).
180 160 140 120 100 80 60 40 20 0
Lesions stationary.
Moderately improved. Bacteriologically still positive.
Lesions the same as the last examination bacteriologically positive.
1 1 2
0 0
Temperature.
37. 36.5 37.2
Lepra reaction.
− − ⊕ ⊕
Wassermann and Kahn tests.
++++ +++ ++ + ±
O
= Curve of the Kahn test.
= Curve of the Wassermann test.
⊕ = Positive lepra reaction.
− = Negative lepra reaction.
F.R.

FIG. 3. Leper treated with chaulmoogra and neosalvarsan. Case 3.

tient was given starting from June 4 to November 19, 1932, 12 cc of chaulmoogra (W. E. I.). The Vernes test on November 28 dropped to negative; the Wassermann was ±, but the Kahn test remained + + + +.

Cases 3, 4, and 5 are clinically and bacteriologically positive. These patients received since admission several injections of chaulmoogra. In spite of the treatment the lesions did not im-

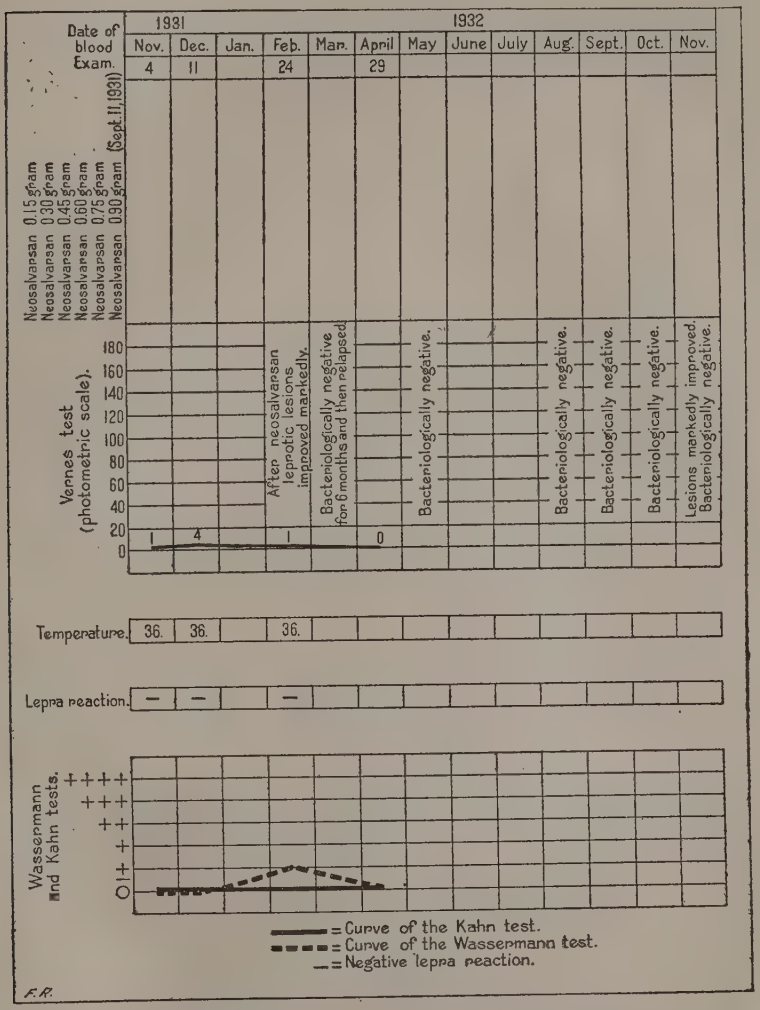

FIG. 4. Leper treated with chaulmoogra and neosalvarsan. Case 4.

prove much, but the blood examinations for the Wassermann and Kahn reactions performed in the laboratory of the hospital showed strongly positive results.

On account of the strongly positive serologic findings these patients were given later neosalvarsan injections (from 0.15 g up to 0.90 g). About seven months after the neosalvarsan treat-

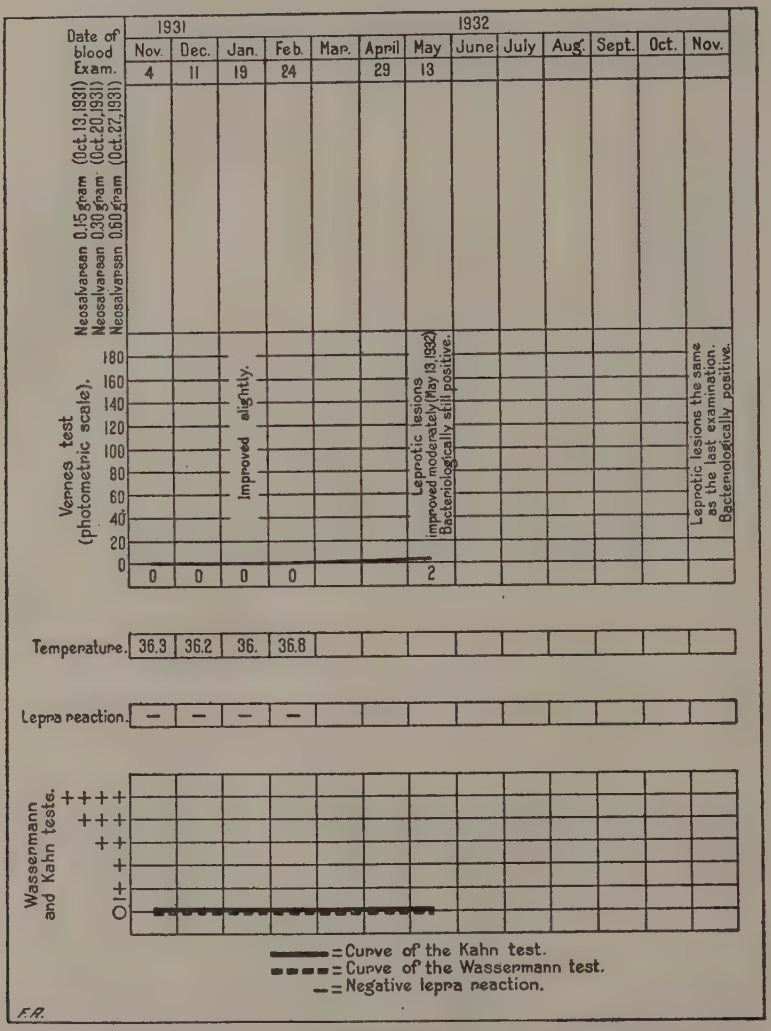

FIG. 5. Leper treated with chaulmoogra and neosalvarsan. Case 5.

ment, cases 3 and 5 showed moderate improvement of the leprotic lesions, and case 4 a marked improvement in about five months. In case 4 the bacteriological examinations of the le-

sions became negative for lepra bacilli, during six months, but at the end of this period the lepra bacilli reappeared in the same lesions to become again negative in May, 1932, up to the present (November, 1932).

The Vernes, Wassermann, and Kahn reactions performed with the blood of all these patients after neosalvarsan treatment, were negative by the three tests, and remained so until the present, a period of one year.

From the above data, it is evident that the results of the three tests under consideration agree with each other, and that the administration of neosalvarsan affects the degree of all of these reactions in a like manner.

The leprotic lesions in our cases improved also after neosalvarsan treatment.

SUMMARY OF THE VERNES, WASSERMANN, AND KAHN TESTS IN EIGHTY-FOUR TREATED AND UNTREATED LEPERS

Summarizing the total of eighty-four lepers treated and untreated positive Vernes test was observed with the serum of twenty-two (26.1 per cent); a positive Wassermann test with the serum of thirty-two (38.0 per cent); and, a positive Kahn test with the serum of eighteen (21.4 per cent).

In seventeen cases the three tests considered were found positive without exception (20.2 per cent).

In not a single case were the Wassermann and Kahn tests found positive and the Vernes negative, while in fourteen cases the Vernes and Kahn tests were negative and the Wassermann was slightly positive (± and + +).

From the above data it seems that the Vernes test behaves in leprosy in a manner similar to the Kahn test. The Wassermann reaction is a little more sensitive, taking into consideration the greater number of patients showing weakly positive reactions of ± to + +; strong reactions, however, are rarely observed with our Wassermann reaction.

THE AGE INCIDENCE IN THE EIGHTY-FOUR LEPERS SHOWING POSITIVE VERNES, WASSERMANN, OR KAHN TESTS

THE RELATION OF POSITIVE SEROLOGIC TESTS WITH THE PRESENCE OR ABSENCE OF LEPRA BACILLI IN THE LESIONS OF THE SAME PATIENTS

In studying the age incidence in lepers showing positive Vernes, Wassermann, or Kahn tests as presented in Table 4, it can be observed that positive reactions occur more frequently in patients over 30 years old than in those under 30 years of age; the percentage being 94.2 and 77.5, respectively.

It will also be noted from the study of Table 5 that positive Vernes, Wassermann, or Kahn tests are more frequent in bacteriologically positive lepers than in those in which the microorganisms cannot be demonstrated. The percentages are 84 and 46.6.

TABLE 4.—*The age incidence in 84 lepers showing positive Vernes, Wassermann, and Kahn reactions.*

Age.	Vernes.			Wassermann.			Kahn.			Positive in the three cases.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
Yrs.			P. ct.			P. ct.			P. ct.		P. ct.
5–10	2	1	50.0	2	1	50.0	2	1	50.0	------	--------
11–19	16	3	18.7	16	9	56.2	16	2	12.5	------	--------
20–29	31	6	19.3	31	10	3.2	31	5	16.1	------	--------
30–39	12	4	33.3	12	3	25.0	12	3	25.0	------	--------
40–49	9	2	22.2	9	3	33.3	9	2	22.2	------	--------
50–67	14	5	35.7	14	6	42.8	14	5	35.7	------	--------
5–29	49	10	20.4	49	20	40.8	49	8	-------	38	77.5
30+	35	11	-------	35	12	-------	35	10	-------	33	94.2

TABLE 5.—*The relation of the positive Vernes, Wassermann, and Kahn tests in connection with the presence or absence of lepra bacilli in the blood of 84 patients.*

Bacteriological findings in the blood.	Vernes.			Wassermann.			Kahn.			Positive in three tests.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
			P. ct.			P. ct.			P. ct.		P. ct.
B. lepræ + ---	69	18	26.0	69	26	37.6	69	14	20.2	58	84
B. lepræ — ---	15	2	13.5	15	3	20.0	15	2	13.5	7	46.6

THE RELATION OF POSITIVE VERNES, WASSERMANN, OR KAHN TO THE TYPES OF LEPROSY

For the purpose of this study, our cases have been classified into three types; namely, the cutaneous (C), the neural (N), and the mixed type (M). This classification is based on the presence of pure dermal or neural manifestations or both. Unfortunately, we have been unable to secure enough cases of the cutaneous and neural types to render our results more valuable.

In this study are considered ten cases with dermal manifestations (cutaneous), five cases of nerve involvement classed as neural, and sixty-nine cases with both neural and dermal (mixed type). The results demonstrated in Table 6 that positive Vernes, Wassermann, or Kahn tests are frequently observed in lepers of the mixed type; the lowest incidence is among the

cutaneous forms. The percentage of positive reactions for any one of the three tests in the three mentioned types of leprosy are the following: Cutaneous type, 12; neural type, 60; mixed type, 82.5.

TABLE 6.—*The relation of positive Vernes, Wassermann, and Kahn tests in connection with the clinical types of leprosy in 84 lepers.*

Types of leprosy.	Vernes.			Wassermann.			Kahn.			Positive in three tests.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
			P. ct.			*P. ct.*			*P. ct.*		*P. ct.*
Cutaneous	10	3	30	10	6	60	10	3	30	12	12
Neural	5	1	20	5	1	20	5	1	20	3	60
Mixed	69	18	26	68	25	36.7	69	14	20.2	57	82.5

CHANGES OBSERVED IN THE RESULTS OF THE VERNES, WASSERMANN, AND KAHN TESTS, IN RETESTING THE SERA OF NINETEEN LEPERS TREATED EXCLUSIVELY WITH CHAULMOOGRA.

For this experiment we selected from the groups of untreated lepers, nine patients who had been recently admitted to San Lazaro Hospital. The blood of these patients, when tested by the Vernes, Wassermann, and Kahn reactions, showed moderate and strong positive results. These patients received later several injections of chaulmoogra for a period of six months to one year, and the changes in the degree of the reactions were observed during these periods of treatment. The results were registered by drawing serologic curves.

Parallel tests were performed with another group of eight patients obtained from these treated groups of lepers who had received variable amounts of chaulmoogra oil in the past. The blood of these patients still showed at the time of the tests positive readings by the Vernes, Wassermann, and Kahn reactions. These reactions, however, were much less pronounced. These lepers have been retested monthly during further chaulmoogra treatment over six months to one year, and further changes in the degree of reactions were observed. None of these cases retested had received antisyphilitic treatment.

From our investigation we conclude that definite changes in the results of the Vernes, Wassermann, and Kahn tests may be noticed by retesting the sera of lepers who received exclusively injections of chaulmoogra. These serological changes, however, are not necessarily accompanied by much improvement in the clinical manifestations of leprosy.

The serologic changes due to chaulmoogra treatment occur in one or in all of the three tests and become evident in that a positive serum becomes negative or that the reactions become stronger or weaker in the course of the treatment.

The three tests are not always comparable, as shown by the fact that the Vernes and Wassermann tests in few cases have become promptly negative or decreased in degree after a short period of treatment, while the Kahn test remained unchanged (fig. 6, cases 1 and 2).

In the majority of cases, however, the Wassermann and, particularly, the Kahn tests remained unchanged for a long period in spite of the continuous treatment with chaulmoogra, but the Vernes test, while still positive, decreased considerably during the same period of treatment (fig. 6, case 3).

In very few patients after few injections of chaulmoogra have been administered the Kahn test first then the Wassermann test became negative, while the Vernes test decreased only to a certain extent (fig. 6, case 4).

Finally, in a few cases all three tests become negative or practically negative, not immediately but after a long period of treatment (fig. 6, case 5).

EXPERIMENTS WITH PHILIPPINE MONKEYS CONCERNING THE EFFECTS OF CHAULMOOGRA TREATMENT UPON THE SEROLOGIC REACTIONS CAUSED BY ARTIFICIAL INFECTION WITH TREPONEMATOSES.

Five Philippine monkeys that had been inoculated about five years ago with syphilis and yaws were used in this investigation. All five monkeys showed strong positive results by the Vernes, Wassermann, and Kahn tests at the time of the experiment.

Only monkey W–43 survived. This monkey had been inoculated with Kadangan and Guzon [6] strains of yaws February 6, 1928, and February 21, 1929, respectively. After the first inoculation with Kadangan strain (February 6 to 28) the animal developed a typical yaws lesion. A superinoculation performed one year after (February 21, 1929) with Guzon strain did not

[6] Kadangan and Guzon strains of yaws were isolated from patients in the Philippine Islands March 4, 1925, and November 15, 1928, respectively. Both strains produced typical local yaws and strongly positive serologic reactions in inoculated monkeys. Both strains have been kept alive by successive passages through Philippine monkeys.

produce yaws lesion as result of immunity that developed against yaws infection. The control monkey developed typical yaws with Guzon strain.

Four months later (June 22, 1929) monkey W–43 received an intradermal inoculation with syphilis (Nichols strain) on the scrotum. The animal did not develop syphilitic lesion. October 22, 1929, the inguinal lymph glands corresponding to the point of inoculation with syphilis were removed asceptically and transplanted to the testicles of two normal rabbits. Neither of these rabbits developed syphilitic lesions. Normal monkeys inoculated with Nichols strain of syphilis developed typical syphilitic lesions, and the lymph glands contained viable *T. luis*, when transplanted to testicles of rabbits.

From this experiment Schöbl[7] concluded that immunity gained by yaws injections protects Philippine monkeys against cutaneous inoculation with syphilis.

Monkey W–43 after his first inoculation with yaws on February 6, 1928, up to the time of our experiment received no injections of antitreponematous drugs whatsoever. Its blood was examined by the Vernes, Wassermann, and Kahn tests before the administration of chaulmoogra oil and showed the following results: Vernes, 30; Kahn, + + + +; Wassermann, + + + +. (See fig. 6.)

This monkey, W–43, received later within a period of one month 7.5 cc of pure chaulmoogra oil in subcutaneous injections at weekly intervals and progressive doses. At the end of this period of treatment, the Vernes reaction became almost negative (=5); the Kahn test dropped from 4 plus to negative, and the Wassermann reaction decreased only slightly, from 4 plus to 2 plus.

Later this monkey was given a rest of three months without receiving chaulmoogra oil, and then another sample of blood was withdrawn from his heart and examined by the Vernes, Wassermann, and Kahn reactions. The results of this last examination showed the following: Vernes, negative (=2); Kahn, negative; Wassermann, ±.

GENERAL SUMMARY

The blood of eighty-four lepers was examined; namely, eighty-one Filipinos, two Chinese, and one native of Guam. Forty-six of these patients received no injection of chaulmoogra prepara-

[7] Philip. Journ. Sci. 43 (1930) 263.

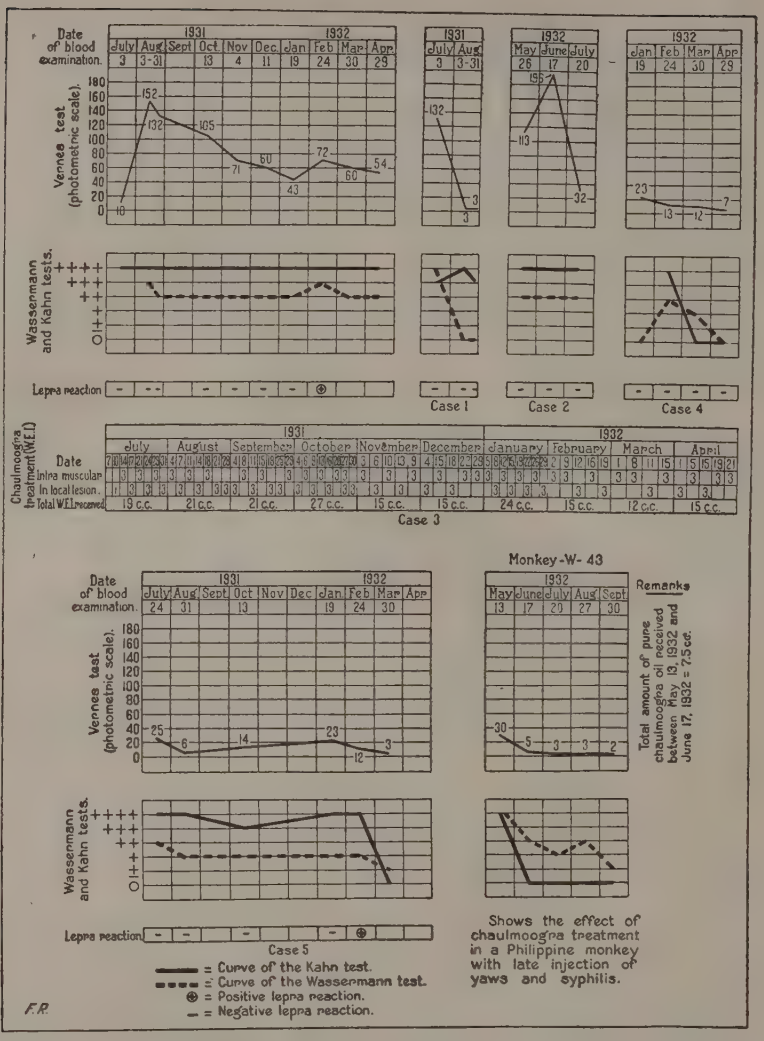
Date of blood examination.
Vernes test (photometric scale).
Wassermann and Kahn tests.
Lepra reaction
Case 1
Case 2
Case 4
Chaulmoogra treatment (W.E.I.)
Intra muscular
In local lesion.
Total W.E.I. received
Case 3
Monkey-W- 43
Remarks
Total amount of pure chaulmoogra oil received between May 13, 1932 and June 17, 1932 = 7.5 cc.
Case 5
Shows the effect of chaulmoogra treatment in a Philippine monkey with late injection of yaws and syphilis.
= Curve of the Kahn test.
= Curve of the Wassermann test.
= Positive lepra reaction.
= Negative lepra reaction.
F.R.

Fig. 6. The effect of chaulmoogra injections on the serologic curve of the Vernes, Wassermann, and Kahn reactions.

tion whatsoever before the time of the experiment. Of the rest, thirty-three lepers received chaulmoogra injection, and five patients received besides chaulmoogra also antitreponematous treatment.

The results obtained with the Vernes, Wassermann, and Kahn methods are compared. They show a general agreement of re-

sults, both in untreated and treated lepers. It seems, however, that the Vernes test behaves in leprosy more like the Kahn test and that the positive reactions obtained with these tests in lepers are usually stronger compared with the results of our Wassermann reaction. However, there are more lepers showing weakly positive Wassermann reaction (1 plus to 2 plus) than positive Vernes and Kahn tests.

In the total of eighty-four lepers the positive percentage of the Vernes test is 21.6, the positive percentage for Wassermann reaction is 39.2, and the positive percentage for the Kahn test is 21.4. The percentage of positives without exception for all three tests is 17.8.

The relation between the serologic results, taking into consideration the age of the patients and the clinical and bacteriological forms of the disease, is also discussed. Our findings demonstrated that positive reactions occur more frequently in patients over 30 years old (94.2 per cent) than in those under 30 years of age (77.5 per cent).

Positive serologic findings have been more frequent among lepers with lepra bacilli in the lesions (84 per cent) than among lepers with negative bacteriological findings (46.6 per cent).

Positive serologic reactions for any one of the three tests in the varieties of leprosy (dermal, neural, and mixed) were more frequently observed in the mixed type of leprosy (82.5 per cent).

The effects of chaulmoogra and neosalvarsan treatments upon the serologic results and the improvement of lesions are also discussed.

Our experiments showed that the exclusive and continuous administration of chaulmoogra in leprosy may bring about a marked decrease of the positive serologic reactions encountered in lepers. This decrease in the serologic curve, however, is not always immediately accompanied by much improvement of the leprous lesions.

In a very limited number of lepers, who received besides chaulmoogra injection also antitreponematous treatment, the results of the three tests under consideration agree with each other and the administration of antitreponematous drug (neosalvarsan) affects also the degree of these reactions in a like manner. In these few cases studied a more rapid and marked improvement of the leprotic lesions was noted after neosalvarsan treatment.

The exclusive administration of chaulmoogra oil in Philippine monkeys showing positive serologic findings with the Vernes,

Wassermann, and Kahn reactions may bring about also a decrease in the positive serologic reactions due to long standing infection with yaws and syphilis in these animals.

In the course of this study it has been noted repeatedly that of the three applied methods—that is, Wassermann, Kahn, and Vernes reactions—the Vernes reaction answered more promptly in manifesting the quantitative changes of the serologic findings which ensued as a consquence of chaulmoogra treatment.

CONCLUSION

1. In the serum of lepers, the Vernes, Wassermann, and Kahn reactions were found positive in 17.8 per cent of the cases examined (84) without exception in all three tests.

2. The positive Vernes, Wassermann, and Kahn reactions in lepers may be converted to negative reactions after prolonged administration of chaulmoogra oil exclusively. These serologic changes, however, are rarely observed immediately with the ordinary Wassermann and Kahn methods but only after several months of continuous treatment. In the case of the Vernes test marked quantitative changes are easily demonstrated after a few injections of chaulmoogra.

3. The favorable quantitative changes observed in the serologic curve of the Vernes, Wassermann, and Kahn reactions as a result of chaulmoogra treatment are not always accompanied by marked improvement of the leprous lesions.

4. The positive blood findings with Vernes, Wassermann, and Kahn reactions in Philippine monkeys with latent experimental infections of yaws and syphilis are converted also to negative or almost negative under the influence of exclusive administration of chaulmoogra oil.

ACKNOWLEDGMENT

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Leper treated with chaulmoogra and neosalvarsan. Case 1.
2. Leper treated with chaulmoogra and neosalvarsan. Case 2.
3. Leper treated with chaulmoogra and neosalvarsan. Case 3.
4. Leper treated with chaulmoogra and neosalvarsan. Case 4.
5. Leper treated with chaulmoogra and neosalvarsan. Case 5.
6. The effect of chaulmoogra injections on the serologic curve of the Vernes, Wassermann, and Kahn reactions.

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THE FISHERY INDUSTRIES OF SOUTHWESTERN SAMAR [1]

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SEVEN PLATES AND EIGHT TEXT FIGURES

Samar, the fourth largest island of the Philippines, lies southeast of Luzon. It is more or less triangular in shape and separated from Sorsogon Province by San Bernardino Strait and from Leyte Island by San Juanico Strait. The low but numerous mountain ranges give to Samar a very rugged surface. The topography of the island being such, the majority of the towns are located along the coast, where fishing is almost the only practicable mainstay of the people, especially along the southwestern coast—the second district, where, according to estimates, no less than 300,000 pesos is invested in boats, gear, and other appliances used in the catching of fish. The municipalities of this district net an aggregate yearly collection of about 15,000 pesos based on taxes derived from this industry alone. There is here a predominance of rich and favorable fishing grounds along this portion of the coast line, the region of many islets and islands being less exposed to the two prevailing monsoons of the year. Although Samar lies directly in the path of typhoons, such disturbances cause only a brief interruption of the fishing activity. Maqueda and Villareal Bays and the surrounding waters teem with fish.

Plate 1 shows a map of the regions covered in this survey together with the extent of their fishing grounds. The condition and the relative importance of the fishing industry in each of the municipalities, from Gandara in the north to Basey in the south, observed during the time of the survey (March, 1932), are presented in the following paragraphs.

Gandara.—Gandara is an interior town, located alongside Gandara River. It is more of an agricultural town than a fishing community, its sea fisheries being confined to the vicinity of the

[1] Contribution No. 6 from the Fish and Game Administration, Department of Agriculture and Commerce.

mouth of the river, where fish corrals abound during the northeast monsoon—the deep-water corrals (*paugmad*) at Napalisan Barrio and the shallow-water corrals (*pahubas*) at Opong Barrio. To a certain extent anchovies are caught around its jurisdiction by the *lawag* fishers of other municipalities, in which case a tax is collected.

To a very limited extent fresh-water fish are caught for home consumption in Gandara River by individual fishermen. The commoner species [*aguas* (mullet), *Mugil* spp.; *mulan bulan* (tarpon), *Megalops cyprinoides* (Brouss.); *haruan* (murrel), *Ophicephalus striatus* Bl.; *gongong* (grunt), *Therapon* spp.; snappers, family Lutjanidæ and sharks] are caught by hook and line and such nets as the *anud* and the *solambao*.

The swamp lands are narrow fringes at the mouth of the river. Although their soil is favorable for fishpond construction, their narrowness makes them unsuitable for utilization.

Tarangnan.—As this is a coastal town, situated on land with a more or less rugged surface, fishing is among the important industries of the people. The presence of bays and indentations along its coasts renders it a favorable abode of fish. Although the inhabitants fish mainly by means of fish corrals similar to those found in Gandara, the municipal government collects a good income from fishermen of other municipalities who come to fish within its rich fishing areas. There is but one locally owned lawag outfit in this region, but due to the abundance of anchovies here, several outfits from neighboring towns fish around its municipal jurisdiction. Because of the absence of preservation plants and the very limited market for fresh fish, the catches are usually sold in Catbalogan.

Catbalogan.—Catbalogan, the capital of Samar, is the real fishing center of the southwestern coast. It is ideally located at the head of a small bay at the mouth of Catbalogan River; it is not only a central market for the merchandising of the catch, but its municipal waters are rich fishing grounds. Catbalogan is a fishing town as well as a commercial center. Practically all barrios of Catbalogan are fishing villages, agriculture being almost impossible because of the very rugged nature of the topography. Around Canahauan, Buri, and Basiao Islands are rich fishing grounds for anchovies, mackerels, and various other species.

Catbalogan is the center of the landing of the catch around Maqueda and Villareal Bays. Here salting and drying of the catch is carried on extensively, mostly by Chinese; in fact, there

is only one Filipino engaged in this business in Guinsoroñgan, Mercedes, Silanga, and Sierra Barrios. Catbalogan exports both the dried and the salted products to Manila and the Ilocano provinces, and to a certain extent to Hawaii. It is one of the sources, if not the principal source, of *bagoong* in the Philippines. In 1930 the municipal collections of duties imposed on these preserved products amounted to 4,040.48 pesos, which increased to 5,116.72 pesos in 1931. Although some of these products were exported in the form of dried fish, most of them were converted into salted and fermented anchovies or bagoong. For each can of bagoong exported the municipality exacts a duty of 2 centavos. In 1930 no less than 2,000 cans were exported, while in 1931 the exportation amounted to about 2,500 cans. The fishermen engaged in the catching of anchovies by means of the lawag are residents of Catbalogan, where there are no less than twenty such outfits. Aside from the lawag, the *langbat* and the deep-water corrals help to raise the daily hauls of fish to commercial proportions.

Zumarraga.—Next to Catbalogan in importance as a fishing center is the municipality of Zumarraga located at the southwestern end of Buad Island. It is the least suitable for agriculture, but its surrounding waters are extensive and rich fishing grounds. Anchovies are caught in abundance the year round. While the fishing activities in Catbalogan are somewhat affected by the southwest monsoon, here, because of the ideal location of the island, they are practically continuous since they may be shifted from one side to the other with the change in the direction of the wind. Thus when the lawag outfits of Catbalogan are unable to operate in their vicinity they oftentimes switch their activity to these regions.

The municipal council has recently passed an ordinance imposing the prohibitive tax of 1,000 pesos per annum on the lawag. This action has brought about a considerable decrease in the income of the municipality from the fisheries, as most of the lawag fishers registered in the neighboring municipality, Villareal, which imposes only 150 pesos per annum. These outfits actually fish in Zumarraga waters close to the boundary of the two municipalities, so that if an attempt is made to arrest them they can easily row to the waters of Villareal.

The market for fresh fish is very limited, and although drying is carried on along the beach near the townsite, there are no large preservation plants, and most of the hauls of the fishermen are brought to Catbalogan and marketed there. Ilongo

sailboats (boats from Iloilo Province) usually call at Zumarraga to purchase fish.

The principal gear used here are lawag, fish corrals, *baring*, and *bahan*.

Wright.—Wright, formerly Paranas, is located at the head of Maqueda Bay. Although ideally located for fishing, it does not have an extensive fishing industry. There are no fish nets in this region and fishing is carried on only by means of shallow-water fish corrals. The coasts are fringed with narrow strips of swamp lands; the soil is suitable for fishponds, although typhoons constitute a great menace and the townsite itself has been gradually eaten away by the sea. Bañgos are said to enter the swamps, and most probably bañgos fry are found here along the sandy coasts at the mouths of rivers.

Calbiga.—Like Gandara, this town is located in the interior, where fishing is insignificant. Swamp lands along the coast were observed, but no detailed survey was conducted.

Villareal.—This municipality is situated at the southern head of Villareal Bay; the latter is so rich a fishing ground that fishermen from Zumarraga and Catbalogan often visit it, especially the lawag outfits. As there are no preservation plants here and the market for fresh fish is limited, the catches are taken to Catbalogan.

The most important gear used are the bahan, fish corrals, and baring. Talalora Barrio is significant, as it is usually visited by Ilongo sailboats for the purchase of fish from the catch around Villareal Bay. These are cured and dried in the boats and later taken to Panay and Bohol.

Santa Rita.—This is another coastal town, situated at the eastern head of Janabatas Channel. Fishing is not carried on extensively. The most important gear employed is the fish corral of the *pangalato* style.

Basey.—Basey is situated at the northern part of San Pedro Bay—a fishing as well as an agricultural town. The principal fishing ground is San Pedro Bay, a rich area, somewhat exposed, especially during the southwest monsoon. Salvacion Barrio, on Jinamoc Island, is settled mostly by Cavite fishermen who have introduced many and varied Tagalog methods of fishing in this locality. The important gear used are various types and styles of fish corrals, the *pante, kitang, laya, conay,* and *cobcob.*

There are no preservation plants here, although small quantities of fish are dried for local consumption. The catches are usually disposed of at the town market and at Tacloban, the

capital of Leyte—the latter only twenty minutes from Basey by motor boat. Swamp lands along the banks of the mouth of Basey River appear to be good fishpond sites, but limited in extent.

Table 1, obtained through the courtesy of the office of the provincial treasurer, shows the approximate annual income derived from the fisheries of each of the municipalities of the second district and serves to indicate the relative importance of the fishing industry in each.

TABLE 1.—*Income from fisheries in Samar.*

Municipality.	1930	1931	1932
	Pesos.	*Pesos.*	*Pesos.*
Gandara	127.25	127.25	127.25
Tarangnan	2,056.00	1,027.00	(a)
Catbalogan	2,220.00	2,220.00	6,170.00
Zumarraga	7,759.15	6,072.65	475.75
Wright	487.00	432.50	427.20
Calbiga	71.00	71.00	59.50
Villareal	923.50	611.50	(a)
Santa Rita	632.76	588.80	(a)
Basey	1,518.00	894.00	83.00
Total	15,794.66	12,050.70	

[a] No figures were available.

As shown in Table 1 the real fishing activities of the second district center around the municipalities of Tarangnan, Catbalogan, and Zumarraga. Although varied species of food fishes are caught here, it was observed during the course of the survey that the bulk of the catch is composed of anchovies (bolinao) which are caught on a commercial scale and dried or salted. According to the fishermen of these regions the anchovies caught during the warm months of the year are full grown, some having been observed to contain eggs, while those taken during September are usually small. Although no detailed study on the spawning habits of this fish has been conducted in the Philippines, the breeding season may be assumed to occur during the warm or dry months of the year from March to May.

Next in importance to the anchovies are the mackerels. Most of these are caught by the langbat or cobcob and in fish traps or *bunuan*. Two species are common—the *burao* (striped mackerel), *Rastrelliger chrysozonus* (Rüppell), and the *aguma-a* (short-bodied mackerel), *Rastrelliger brachysomus* (Bleeker), the latter locally known as *hasa-hasâ* when immature.

The oceanic bonito (*Euthynnus yaito* Kishinouye) and the frigate mackerel (*Auxis* sp.) are caught in great quantities at certain seasons. Other species caught in varying quantities and either sold locally in the fresh state or cured for exportation, are listed in Table 2.

TABLE 2.—*Local names of fishes.*

Samareño.	English.	Scientific name of commonest species in the market.
Abo	Croaker	Sciænidæ.
Abo-abo	Grouper	*Epinephelus undulosus* (Quoy and Gaimard).
Aguut	Grunt	*Pomadasys hasta* (Bloch).
Alhó	Ten pounder	*Elops hawaiensis* Regan.
Alibang-bang	Butterfly fish	Chætodontidæ.
Alimosang	Catfish	Siluridæ.
Apahan	Cavallas	Carangidæ.
Arad-ad	Grunt	*Therapon* spp.
Babakolan	Cavallas	*Caranx sexfasciatus* Quoy and Gaimard.
Bag-añgan	Porgy (immature)	*Lethrinus opercularis* Cuvier and Valenciennes.
Bagaong	Grunt	*Therapon jarbua* (Forskål).
Baghak	Grouper	*Epinephelus megachir* (Richardson).
Bakagan	Slipmouth	*Leiognathus daura* (Cuvier).
Balira	Dorab	*Chirocentrus dorab* (Forskål).
Balo	Garfish	Belonidæ.
Bañgan	Ambassid	Ambassidæ.
Bañgros	Milkfish	*Chanos chanos* (Forskål).
Banogon	Cow-nosed ray	*Rhinoptera javanica* Müller and Henle.
Barewan	Guitar fish	*Rhynchobatus djiddensis* (Forskål).
Bayang	Drepane	*Drepane punctata* (Linnæus).
Bolinao	Anchovy	Engraulidæ.
Boris	do	*Stolephorus indicus* (van Hasselt).
Bugiw	Halfbeak	Hemiramphidæ.
Calapeon	Hardtail	*Megalaspis cordyla* (Linnæus).
Codosan	Hammer-head shark	*Sphyrna zygaena* (Linnæus).
Cogtong	Grouper (large)	Serranidæ.
Dahonan	Sting ray	*Dasybatus warnak* (Forskål).
Dapak	Red snapper	*Lutjanus malabaricus* (Schneider).
Darapogan	Leaf fish	*Platax orbicularis* (Forskål).
Dumpilas	Big-eyed herring	*Ilisha hoeventi* Bleeker.
Gabilan	Grunt	*Spilotichthys pictus* (Thunberg).
Gela-gela	Crevalle	*Caranx kalla* Cuvier and Valenciennes.
Genok	Goatfish (immature)	Mullidæ.
Gongong	Grunt	*Therapon* spp.
Hamorok	Mojarras	*Gerres punctatus* (Cuvier and Valenciennes).
Haruan	Murrel	*Ophicephalus striatus* Bloch.
I-ito	Catfish	*Plotosus anguillaris* (Bloch).
Kabasi	Gizzard shad	*Nematolosa nasus* (Bloch).
Kikiro	Spadefish	*Scatophagus argus* (Boddaert).
Kini	Shark sucker	*Echeneis naucrates* (Linnæus).
Kirawan	Porgy (large)	*Lethrinus opercularis* (Cuvier and Valenciennes).
Labonñgan	Snapper	*Lutjanus* spp.
Laguis	Croaker (large)	Sciænidæ.

TABLE 2.—*Local names of fishes*—Continued.

Samareño.	English.	Scientific name of commonest species in the market.
Lambiao	Crevalle	*Caranx leptolepis* (Cuvier and Valenciennes).
Lañgisi	Snapper (red)	*Lutjanus* spp.
Lapis	Leather jacket	*Chorinemus lysan* (Forskål).
Lawayan	Slipmouth (large)	*Leiognathus equulus* (Forskål).
Lumo-an	Slipmouth	*Leiognathus* sp.
Lumod	Swordfish	*Xiphias gladius* Linnæus.
Lusod	Barracuda (large)	*Sphyraena jello* (Cuvier and Valenciennes).
Macatod	Snapper	*Lutjanus vitta* Quoy and Gaimard.
Magca-agum	Crevalle	*Caranx djedaba* (Forskål).
Magcotcot	Scolopsid	*Scolopsis bimaculatus* (Rüppell).
Malamban	Halfbeak	Hemiramphidæ.
Mararapad	Gizzard shad	*Anodontostoma chacunda* (Hamilton–Buchanan).
Matang baca	Crevalle	*Caranx boops* Cuvier and Valenciennes.
Modbod	Milkfish (spawner)	*Chanos chanos* (Forskål).
Moong	Cardinal fish	*Amia* spp.
Mulan bulan	Tarpon	*Megalops cyprinoides* (Broussonet).
Muray buray	Silver batfish	*Monodactylus argenteus* (Linnæus).
Nepis-nepis	Slipmouth	*Leiognathus ruconius* (Hamilton–Buchanan).
Ogdok	Eel (marine)	Murænesocidæ.
Osoos	Whiting	*Sillago sihama* (Forskål).
Pagapa	Lactarid	*Lactarius lactarius* (Bloch and Schneider).
Pakañgan	Sawfish	Pristidæ.
Pating	Shark	Galeidæ.
Perisan	Sting ray	*Dasybatus kuhlii* (Müller and Henle).
Sagisi-on	Nemipterid	*Nemipterus japonicus* (Bloch). *Nemipterus taeniopterus* (Cuvier and Valenciennes).
Sandatan	Pomfret	*Stromateus niger* (Bloch).
Sapsap	Slipmouth (small)	*Leiognathus equulus* (Forskål).
Saraming	Cavallas	*Caranx* spp.
Sarañga	Devil ray	Mobulidæ.
Silag	Herring	*Clupeoides lile* (Cuvier and Valenciennes).
Silag-habato	Big-eyed herring	*Ilisha hoevenii* Bleeker.
Sinao-an	Caesio	*Caesio* spp.
Sorahan	Surgeon fish	*Acanthurus* spp.
Subla	Grouper	*Ephinephelus* spp.
Sugui	Halfbeak	Hemiramphidæ.
Sunog	Flathead	*Platycephalus* spp.
Tabangkô	Barracuda (small)	*Sphyraena* spp.
Tabañgoñgo	Catfish	Ariidæ.
Talhô	Lizard fish	*Saurida tumbil* (Bloch).
Tamban helos	Herring	*Dussumieria* sp.
Tamban lirayan	Round-bodied herring	*Sardinella fimbriata* (Cuvier and Valenciennes).
Tamban lison	Sardine	*Sardinella longiceps* (Cuvier and Valenciennes).
Tamban yapad	Deep-bodied herring	*Sardinella perforata* (Cantor).
Tañgigui	Spanish mackerel	*Cybium commersoni* Lacépède.
Tase	Sergeant fish	*Rachycentron canadus* (Linnæus).

TABLE 2.—*Local names of fishes*—Continued.

Samareño.	English.	Scientific name of commonest species in the market.
Tarakitok	Cavallas	*Caranx* spp.
Tawa-ay	Threadfish	*Alectis* spp.
	Jack	*Hynnis momsa* Herre.
Tiao	Goatfish (large)	Mullidæ.
Tiñgag	Grouper (immature)	Serranidæ.
Toros	Siganid	Teuthidæ.
Turiñgan	Tuna	Thunnidæ.

FISHING METHODS

Fishing in Samar, as in other regions of the Philippines, has been confined to pelagic and shore activity. With few exceptions the methods employed, although varied and numerous, are antiquated. Fishing is carried on in dugouts, motor boats being used only for towing the former to and from the fishing grounds. The nets are of fine mesh and, therefore, heavy, so that many fishermen are required for their operation. The methods of fishing range from the catching of fish with the hands to the employment of light in net fishing for anchovies on a commercial scale. Many of the gear used have been introduced by fishermen from Bohol and Luzon.

The sapiao.—Of first commercial importance is the sapiao, a round haul seine of cotton twine. Here two kinds of sapiao are distinguished—the ordinary *sapiao de cuerdas,* or simply *de cuerdas,* and the *sapiao lawag,* or simply *lawag*—the former obsolete, having been replaced by the latter.

At first the sapiao de cuerdas was employed in the extensive anchovy fisheries of this region. Later was added to it the use of light, at the start only in the form of a petroleum torch, locally known as *dukalwong.* Finally the "gral," an incandescent gasoline lamp, was employed, and is still used in the present lawag.

A lawag outfit is composed of a motor boat of about 9 tons gross equipped with a 25-horsepower crude-oil engine, two *sapiao-an,* three *lawagan,* and one sapiao. This is operated by a crew of from 32 to 35 men.

The motor boat acts as a mother ship, towing the baroto to and from the fishing ground. The sapiao-an are ordinary dugouts of not more than 3 tons, each provided with one outrigger so that they can come close to each other in the actual fishing operation. These are the fishing boats proper and are

at the same time used for loading the catch. Often an extra sapiao-an, the *convoy*, is towed for loading large catches. The lawagan are small dugouts provided with two outriggers and a stand, the latter employed to hold one or two grals. These gasoline lamps, which are used to attract the anchovies, have an intensity of from 1,200 to 1,600 candle power.

The sapiao or the net proper, as stated in the foregoing paragraphs, is a round-haul seine of cotton twine, which in actual operation is converted into a huge dip net by the hauling in of the bottom line. It is a somewhat rectangular net with a width of from 100 to 300 feet and a depth of from 150 to 400 feet. The sides are selvaged with three meshes of No. 18 [2] twine towards the inside and four meshes of No. 21 or No. 22 towards the outer edge. The float-line is provided with about sixty one-bamboo-joint floats attached at intervals of 5 feet. To the bottom line are attached sixteen ropes called *palihan*, or pull ropes, which are $\frac{3}{4}$-inch abacá ropes, each about 250 feet long, used for hauling in the bottom line. Eight ropes are held by eight men from each of the two sapiao-an. Of the eight ropes in each sapiao-an, four carry 2.2-pound stone weights—the first two ropes towards the bow with three weights; the third with two and the fourth with one. The structure of the entire net is shown in fig. 1.

The crew of from 32 to 35 men are fishermen who work during the dark of the moon. They are usually paid in advance and are under contract to work until they cover the payment of the advance—their share being computed according to the market prices of the catch for that day. They are, as a rule, given free food, and each is given the privilege of selecting the bigger fishes included in the catch for home consumption. This they term *recalmon* which oftentimes amounts to more than enough for their families; in that case they sell the remainder at the fresh-fish market.

The motor boat tows one or two outfits (4 to 12 barotos) to the fishing ground. They usually start at 3 o'clock in the afternoon and reach the fishing ground exactly at dusk. The lawagan are then given their supply of oil and matches, whereupon they station themselves at different points where fish are supposed to be abundant. The grals are lighted, and in the meantime the two sapiao-an, with the net shared equally in each of

[2] The standards are those used in the Philippines.

them, drop anchor and lie in wait. When large schools have been attracted by a lawagan, the *timonel* (steersman) of the latter blows his conch-shell horn, whereupon the two sapiao-an approach to a distance of about 300 feet. Then the net is laid out from the two sapiao-an, the bunt first and then the wings. The entire net is completely stretched out in the form of a semicircle by the spreading apart of the two sapiao-an which have lain side by side; simultaneously the fishermen let loose the pull ropes so that the entire gear hangs vertically from the surface of the water in the form of a curtain. As the net is always set against the current, it bulges at the center forming a bag.

The lawagan then enters the inclosed area leading or escorting the school of anchovies. The two sapiao-an are then rowed towards each other, while simultaneously the eight men in each gradually haul in the pull ropes. Completely inclosed and the bottom line hauled in, the net is gradually reduced in size by hauling in the wings and concentrating the catch at the bunt; the lawagan is then rowed towards the outside—the timonel of the lawagan supporting the float-line of the bunt. Then the two sapiao-an are rowed towards each other until they lie side by side and are secured to each other by a rope, transforming the gear into a bag, from which the anchovies are brailed out into the boat by dip nets.

This particular lawagan again is on its way to attract other schools, while the other two lawagan are almost ready to be surrounded with the net. The operation is then repeated—this routine of the fishing process being followed from dusk until dawn of the next morning. The whole outfit is then towed homeward and in case fishing is good the lawagan are sometimes left behind at the nearest barrio, so that during dusk they may begin their work before the entire outfit arrives.

The catch consists largely of anchovies (bolinao) of which three distinct kinds are known—the *parañganon*, the *kawayanon*, and the *boris*. Included in the hauls are also small amounts of mackerel, barracuda, herring, cutlass fish, dorab, and squid. A fishing trip usually nets a catch of from 50 to 300 *fanegas* (1 fanega equals 11 pounds). A fanega of fish has a market value of from 0.50 to 3 pesos.

The catch of the lawag, like that of the other fishing gear, is divided into three parts after all expenses have been deducted.

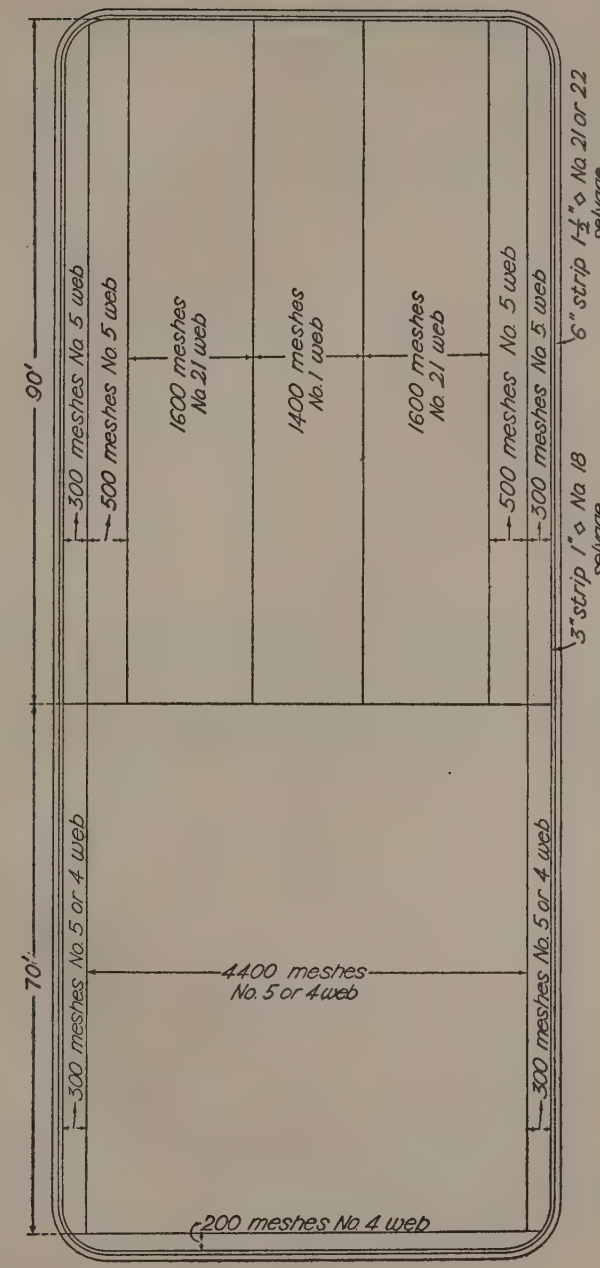
90'
70'
300 meshes No. 5 web
500 meshes No. 5 web
1600 meshes No. 21 web
1400 meshes No. 1 web
1600 meshes No. 21 web
500 meshes No. 5 web
300 meshes No. 5 web
6" strip 1½" ◇ No. 21 or 22 selvage
3" strip 1" ◇ No. 18 selvage
300 meshes No. 5 or 4 web
4400 meshes No. 5 or 4 web
300 meshes No. 5 or 4 web
200 meshes No. 4 web

Fig 1. Structure of the sapiao lawag; diagrammatic.

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One-third is for the owner of the apparatus and two-thirds are for the crew—the timonel receiving more than the others.

The cost of an outfit is as follows:

	Pesos.
1. Motor boat	6,000.00
2. Three sapiao-an	900.00
3. Three lawagan	90.00
4. Three gral	270.00
5. Net (lawag)	900.00
Total	8,160.00

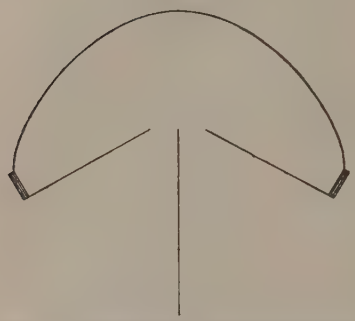

FIG. 2. Inangcla bunuan without any pound or cribs on one side only; diagrammatic.

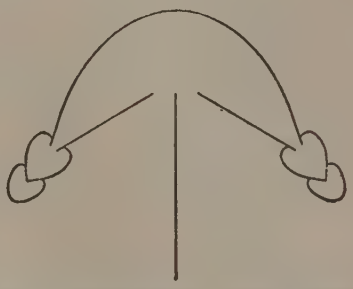

FIG. 3. Inangcla bunuan with two pounds or cribs on each side; diagrammatic.

The sapiao de cuerdas is of the same construction as the lawag although the interior netting of the former is of wider mesh and larger twine—No. 10 twine with a mesh of from $1\frac{1}{2}$ to $1\frac{3}{4}$

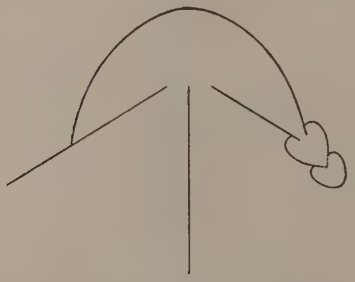

FIG. 4. Inangcla bunnan with two pounds or cribs on one side and a prolongation of the wing on the other; diagrammatic.

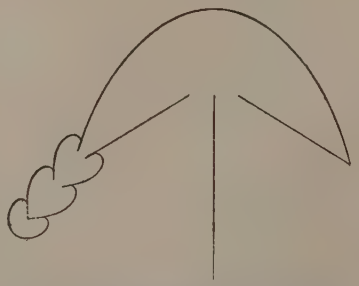

FIG. 5. Inangcla bunuan with three pounds or cribs on one side only; diagrammatic.

inches stretched. The de cuerdas, unlike the lawag, is operated without the use of light although fishing is also done during dark nights. The meshes being wider, this gear catches the larger

species of fish such as cutlass fish (lahing), large milkfish (modbod), spotted mackerel (aguma-a), etc.

The bunuan (fish corrals).—Next in importance are the fish corrals locally known by the general vernacular name "bunuan." These bunuan are either the deep-water or the shallow-water fish traps. They are usually set in November or December and removed in May or June, the season being within the northeast monsoon.

Various styles of bunuan were observed, the most common being the *inangcla*, a style introduced here by Cavite fishermen (figs. 2 to 5). This is planted in either shallow or deep water. The shallow-water bunuan of this style are constructed of bamboo poles and matting of split bamboo strips, requiring an investment of from 20 to 100 pesos. Here the catch is concentrated in a pound or crib from where it is brailed out by means of a dip net.

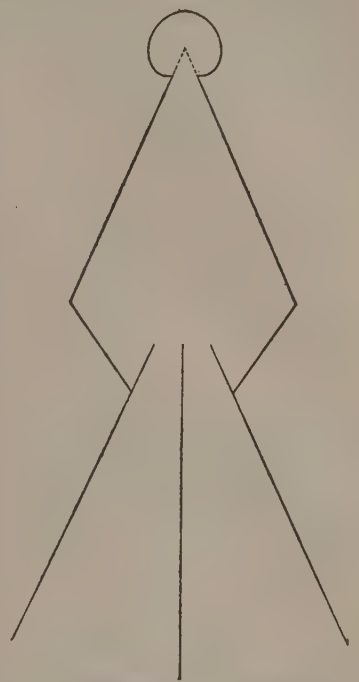

FIG. 6. Pangalato style of bunuan; diagrammatic.

The deep-water bunuan of the inangcla style are constructed at a depth of from 9 to 11 fathoms, *palma brava* being used for posts. These deep-water fish traps may or may not have a pound. When they are not equipped with a crib, as those common in Catbalogan and Basey, the catch is collected by seining the heart with a drag net locally known as *siguin*. This deep-water trap, known as *paugmad* in Calbayog and Tarangnan and as *habug* in Basey, may require an investment of from 3,000 to 4,000 pesos.

Another style of fish corral is the *pangalato* commonly seen around the municipal waters of Santa Rita and Basey. A diagram is shown in fig. 6. The pangalato, a shallow-water fish trap constructed close to the shore, requires a capital of about 150 pesos.

For shallow water, however, the commonest style in use is the *bunuan ordinario*, fig. 7, constructed of bamboo poles and *banata* (split-bamboo matting). The catch is collected in a crib from which it is brailed out by means of a dip net. The cost is almost the same as that of the shallow-water inangcla bunuan. The bunuan ordinario is of the style common in Bunuanan and Jiabong Barrios, of Catbalogan, and in Wright.

Besides the sapiao, nets of commercial importance are the various types of seines (langbat, baring, bahan, and ligcop); several kinds of gill nets (malawâ, salibut, kayagkag, banata, and pante); an assortment of huge dip nets (sodsod, solambao or conay, and cabiao); and the cast net (laya).

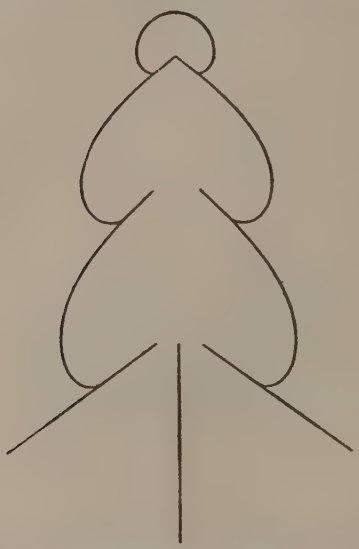

FIG. 7. Bunuan ordinario (shallow water); diagrammatic.

Langbat.—This is an introduced fishing gear, the original being the cobcob or purse seine. The Samareño fishermen, believing that it works just as well without pursing the bottom line, have done away with the purse rings, transforming the gear into a sapiao. This net ranges from 500 to 1,000 feet in length and from 75 to 250 feet in depth. The floatline is provided with wooden floats set about a foot apart, while the bottom line is weighted with lead sinkers attached at intervals of from 3 to 9 inches. The webbing is of No. 5 cotton twine with a mesh of 2 inches stretched. This gear catches pelagic species that run in schools, such as aguma-a, burao, and *turiñgan*. The entire outfit, including one banca, represents an investment of about 1,000 pesos.

Baring.—This is a beach seine of sinamay, which may or may not have a bag, and is operated either with or without the use of light. When used with the aid of light an outfit is composed of one *bariñgan*, one lawagan with one or two grals, and one net or *baring* proper.

The bariñgan is a dugout similar to the sapiao-an, which in this case is used for loading and transporting the net and the

catch. The lawagan, just like that of the lawag, is provided with one or two gasoline lamps (gral). The baring is about 380 feet in length with a depth of from about 14 feet at the wings to about 25 feet at the bunt or the central portion. The sides are selvaged with hand-made abacá twine about $\frac{1}{8}$ inch in diameter, with a mesh of about 3 inches stretched. The upper line is provided with wooden floats and the bottom line with lead sinkers. These lines are prolonged into the wing bridle to which is attached the wooden brail. To the bridle is attached the palihan, a rope about $\frac{1}{2}$ inch in diameter, which is used for drawing the net to the shore. The structure of a baring is shown in fig. 8. An outfit of this type requires an investment of from 300 to 350 pesos.

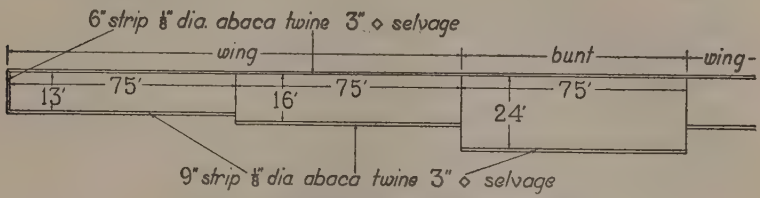

FIG. 8. Structure of the baring; diagrammatic.

Fishing is also done in the evening in the dark of the moon. The lawagan attracts schools of fish, and in the meantime the baring is set at a point free from rocks, where it can be dragged freely to the shore. The lawagan then escorts the school of fish to where the baring has been set. The baring is then hauled towards the shore. The catch consists mostly of anchovies with a mixture of other species.

When the baring is used without the aid of light it is an ordinary *chinchorro,* or beach seine, which may be operated either during the day or at night.

Bahan.—This outfit is a very common gear in Villareal. It is used to catch coral-reef fishes similar to the hauls of the Japanese muro-ami outfits. The gear itself is a baring which serves as the bunt and the bahan proper (the scareline composed of coco-palm leaves, each 500 feet long) attached to the ends of the wings of the baring, thus serving as the wing of the outfit.

The baring is paid out in the form of a semicircle, followed by the bahan toward each wing. Eight divers then pull the bahan, scaring and driving the fish towards the baring. Inclosed in the baring the catch is hauled towards the shore.

This type of fishing gear requires a capital of from 200 to 250 pesos.

Ligcop.—Another net employed in catching coral-reef fish is the ligcop (Plate 3, fig. 3), a drag seine with a length of from 900 to 1,500 feet and a depth of about 8 feet. The netting is of hand-made abacá twine about $\frac{1}{4}$ inch in diameter, knitted by hand with a mesh of $1\frac{1}{2}$ inches stretched. The cork line is provided with wooden floats, while the ground line is anchored by means of stone weights. In actual operation the cork line is submerged and held in place by means of three bamboo poles attached to it and held by three men in three bancas.

After a school of fish has been surrounded, one end of the net is gradually hauled towards the shore, women and children being employed in drawing the pull rope. Three to four divers continuously free the ground rope from rocks, for this gear is operated along rocky shores at a depth of about 10 fathoms. The catch is then concentrated at the other end, whence it is hauled along the shore.

Among the gill nets commonly employed are the malawâ, the salibut, the kayagkag, the banata, and the pante.

Malawâ—This gear is used in deep water. It is from 350 to 750 feet long and from 18 to 25 feet deep, with a netting of hand-made abacá twine $\frac{1}{16}$ inch in diameter and knitted with a mesh of 6 inches stretched. To the cork line are attached "bitoon" floats; the ground line is never weighted. The net, when paid out (always perpendicular to the direction of the current), hangs vertically from the cork line like a curtain.

Salibut.—The salibut resembles the malawâ in all respects except that its meshes are much smaller (3 inches stretched) and that the bottom line is provided with sinkers either of lead or of conch shells. This gear is usually operated in shallower waters.

Both the malawâ and the salibut are generally operated when and where the current is not very strong. When the current is very strong the malawâ floats while the salibut sinks. The catch of the two differs only in size and consists mostly of cutlass fish, milkfish, leather jacket, etc.

Kayagkag.—The net, which is of hand-knit abacá twine with a mesh of 2 inches stretched, measures about 400 feet in length and about 8 feet in depth. The upper line is provided with wooden floats; the bottom line is not weighted. This net is paid out from a banca in the form of a circle and the inclosed fish are scared into its meshes by means of a plunger (a wooden

pole with a disklike cup at one end). This gear catches shark, mullet, snapper, grunt, and various other larger species.

Banata.—This is very similar to the kayagkag, although the netting is of cotton twine. The upper line is also provided with wooden floats, but the bottom line is weighted with lead sinkers attached every 2 feet. The catch consists mostly of *mararapad* (gizzard shad).

Pante (*Plate 5, fig. 3*).—This is the gill net used by the Tagalog, the gear having been introduced here by the fishermen from Cavite. It is especially common in the Caviteño settlement at Salvacion, Basey. The catch consists mostly of *magca-agum* (hard-tail), *tabañgoñgo* (catfish), *pating* (shark), and *lapis* (leather jacket).

Other fishing contrivances, which are more or less huge dip nets, are the *sodsod,* the *solambao* or *conay,* and the *cabiao.*

Sodsod.—This is an introduced fishing gear corresponding to the sakag of the Tagalog and is very common in Basey. The cross-poles are usually made of bamboo and the netting is of either abacá or cotton twine. The shoes are of coconut husk. When operated at night, a torch (petroleum) is used in connection with it. The catch consists mostly of shrimps.

Solambao, or conay (*Plate 4, figs. 1 and 2*).—This gear is a sodsod without shoes plus a scare line that consists of an abacá rope 200 feet long to which are fastened at intervals coconut husks and buri-palm leaves. The web of the sodsod is of No. 40 cotton thread with a mesh of 1 inch stretched. This is a very common fishing appliance in Catbalogan where it is called *solambao,* and in Basey where it is known as *conay.* A complete outfit, consisting of a net, a scare line, and a banca, is operated by four persons, and requires an investment of about 40 pesos. The catch consists mostly of young mullet.

Cabiao.—This is a more or less square net measuring 20 feet on each side and made of No. 20 cotton thread that is webbed with a stretched mesh of $\frac{3}{8}$ of an inch. The sides are selvaged with coarser twine of the same mesh. It is operated by four men on bamboo stands built at the side of the river. Each corner of this net is attached to a bamboo pole, which in turn is held by each of the four men on the stand. The entire net is sunk into the water in the form of a huge dip net. Upon their discretion the fishermen haul it by lifting the poles. The catch consists mostly of *balanak* (mullet).

A somewhat different method of operating this net was observed in Basiao, Catbalogan. Here one side of the net (the

one away from the shore) is attached to a long one-piece bamboo float, which in turn is attached to two poles stuck into the bottom of the sea. The side towards the shore and parallel to the floated side is weighted with two stones attached to the corner of the square net. The attending banca lies adjacent to the weighted side. When ready to haul, the men from the banca lift the weights and haul the net from this side towards the floated side.

Laya.—This is the cast net (dala) of the Tagalog. It is operated either along wading depths or in deep water. In the latter case a banca is used in connection with its operation. A fleet of laya fishermen from Bunuanan Barrio, Catbalogan, furnishes the fresh-fish market with a daily supply of a delicious fish locally known as *silag*, *Clupeoides lile* (Cuvier and Valenciennes). Another deep-water cast net in use is that designed for catching herring similar to those in Parañaque, Rizal.

Kitang.—This is another introduced fishing appliance, having been brought by the Cavite immigrants. It is operated as in the Tagalog regions and catches large fish, which are sold in the local fresh-fish markets.

Other gear of lesser importance, some of which are already obsolete, are the following:

Anud.—A drifting gill net operated from two bancas.

Kalamba.—A gill net used for catching mullet, mojarra, slipmouth, catfish, etc.

Sarap banata.—A drag net of sinamay about 80 feet long and about 15 feet deep; used for catching shrimps.

Banata pukot.—A drag net similar in construction to the bating of the Tagalog. The net is 400 feet long and from 40 to 60 feet deep, of No. 20 cotton twine with a mesh of 2 inches stretched. Catches hardtails, etc.

Tambog.—A gill net similar to the kayagkag and the banata.

Paeligan.—An inclosure consisting of barricades of stones and rocks, provided with openings where the collecting traps are set.

Sinduk.—This is a sodsod without shoes or sliders.

Padlas.—A gill net, 70 feet long and 70 feet wide, operated from two boats. Before being used the net is immersed among crushed shrimp. The particles of shrimp that stick to the twine serve as bait.

Ragonot.—A gill net, which in operation is aided by the use of a scare line.

Bobo.—A bamboo fish basket serving as a trap.

Tinumpang and guinancho.—Similar to the banata.

Sarap.—A drag seine of sinamay, usually 75 by 20 feet; used for catching shrimps.

Pa-abung.—A gill net, 50 to 75 feet long and 20 feet deep, of abacá twine. It is without floats and weighted with two stones on the bottom line and operated from two bancas. Used for catching gizzard shad.

Arong.—Similar to the bonbon of the Tagalog.

Pabjas.—Synonym of pahubas, a type of shallow-water fish corral.

Pañgawel.—Fishing by trot line or trolling.

FISH-PRESERVATION METHODS

Because of the very limited local market for the voluminous catch, the problem of fish preservation is of paramount importance. The curing and preservation plants are all located in the municipality of Catbalogan, where two barrios, Mercedes and Guinsoroñgan, are almost exclusively devoted to this industry. There are two plants in the former barrio and four in the latter, with but one exception all owned and operated by Chinese. Aside from these plants was one in Silanga Barrio and another small one at Sierra.

The fish-preservation methods employed are similar to those followed in other fishing centers in the Philippines, such as Estancia, Sitanki, and Manila—drying and salting.

Drying.—Two types of catches are dried—the catch of the fish corrals and those of the commercial fish nets (langbat and lawag). The deep-water bunuan are usually seined three times a day; the catch, consisting of several species—crevalle, grunt, pomfret, hairtail, slipmouth, threadfin, croaker, dorab, mackerel, etc.—is brought directly to the preservation plants, although limited amounts are sold at the fresh-fish markets. From the bancas they are placed in baskets (canastros), washed in sea water, and brought to the shed, where they are sorted by size. The small and medium-sized fishes, which are cured in the round, are placed in concrete brining tanks or vats containing strong brine. The surface of this mixture is covered with additional coarse salt, and the solution is used over and over. The fish are left in this solution for from three to five hours, depending upon the size, species, and abundance of fish. Then they are washed in sea water and dried on elevated platforms with split-bamboo matting. From three to five days are required to dry the fish thoroughly.

The large species included in the catch are gutted and split or sliced before undergoing the dry-salting process discussed in the foregoing paragraph.

The langbat catches include the common pelagic species that run in schools, such as the chub mackerel and the herring, although the latter was uncommon during the period of the investigation. The small and medium-sized fish (hasa-hasâ) are prepared in the round, while the large ones are also gutted and split.

The catches of the lawag are mostly anchovies (bolinao). During sunny days, most of the catches of anchovies are dried. From the boats (sapiao-an) the fish are placed in canastros, washed in sea water, and landed and spread to dry on elevated platforms of split-bamboo matting. From time to time the fish are turned over by tilting portions of the somewhat flexible matting, in order that both sides of the fish may dry equally. Here no salt is used, as the anchovies are small and thin enough to be thoroughly dried in the sun. These dried products are packed in sacks and boxes and shipped to Manila, Bohol, Leyte, and other localities.

The following items enter into the cost of producing and transporting one sack of dried anchovies to Manila:

	Pesos.
Raw fish	1.50
Labor	0.40
Cost of sack (container)	0.10
Freight	0.16
Cargador and internal-revenue tax	0.07
Total	2.23

As previously stated, three species of anchovies are distinguished in Samar, each with a different preserving quality—the *paranganon* (*Stolephorus commersonii*), the *kawayanon* (*Stolephorus* sp.), and the *boris* (*Stolephorus indicus*). It is claimed that of the three species the boris is the best for drying as it does not readily rust and therefore commands a higher price. The rusting is due to the oxidation of the fat upon exposure to the air, and the boris apparently contains less fat than the first two species.

Salting of anchovies.—The lawag outfits that supply the raw materials for this industry of preparing "bagoong" locally known as *bodo,* land their catch in the morning. From the holds of the sapiao-an the fish are placed in bamboo baskets (canastros). These are first dipped in sea water before being brought to

the salting shed. In the plant the anchovies are salted in elevated wooden vats (Plate 6, fig. 2), or sometimes in holds of worn-out bancas—the proportion of salt to fish being one part of salt to two parts of fish. The salt and fish are gradually and uniformly mixed together by the use of an enamel plate or a scoop.

The mixture of salt and fish is then placed in concrete vats where it is allowed to cure for from one to three days depending upon the supply of fish. At this stage the vats are usually exposed and give flies an opportunity to deposit their eggs. The vats are covered with webbed bamboo matting, or *sawali*, which does not exclude the flies.

After having undergone curing, the product is placed in 5-gallon petroleum cans by women and children. The cans used are those provided with a more or less circular opening. The containers with the mixture of salt and fish are set aside for a period of one week or more with the circular orifice left open to allow the salted product to cure further and the gaseous formation resulting from the fermentation process to escape. It is essential at this stage to cover this opening temporarily with cheesecloth in order to prevent flies from gaining access to the fermenting product. The cans are then hermetically sealed by soldering a piece of tin plate to the circular opening. The sealed cans are stored for some time before shipment, their condition being observed from time to time. "Swells" are discarded, and the other cans are shipped to Manila, the Ilocano provinces, and Hawaii.

The following items enter into the cost of producing and transporting one can of bagoong to be marketed in Manila:

	Pesos.
Raw fish	0.30
Salt	0.20
Labor	0.10
Cost of can (container)	0.30
Freight	0.20
Total	1.10

Salt used in the preparation of bagoong.—Two types of salt are commonly used; Manila salt (produced by solar evaporation of sea water), which is used by the Chinese, and Ilocano salt (sea or salt-spring water evaporated by artificial heat) by the Ilocanos. The former is coarse, while the latter is fine. The results of the analyses of the two samples, by the Bureau of Science, are given in Table 3.

TABLE 3.—*Analyses of two samples of salt.*

Substance present.	Manila salt.	Ilocano salt.
	Per cent.	*Per cent.*
Alkaline chlorides (by difference)	91.18	94.23
Calcium sulphate ($CaSO_4$)	1.55	4.13
Magnesium sulphate ($MgSO_4$)	3.90	0.93
Magnesium chloride ($MgCl_2$)	2.76	0.59
Iron and aluminum oxide (R_2O_3)	0.003	0.005
Residue insoluble in water	0.61	0.12

From the analyses it is evident that the Ilocano salt is the purer salt, its sodium chloride content being 94.23 per cent and that of the Manila salt 91.18 per cent. The claim of the residents of Samar that the Ilocano product is extremely salty and has a peculiar biting taste is explained by the abundance of calcium salt which, according to Taylor,[3] "has an acrid taste and greatly accentuates the 'saltiness' of salt." Magnesium salts produce the same effect as the calcium, but not to the same degree. The Philippine salts as a whole are quite impure compared with those used in foreign countries. The Turks Island salt, for example, contains 96.52 per cent sodium chloride; the Trepani Italian salt 95.82 per cent; the Iviza Spanish salt 98.05 per cent; the Diamond Flake domestic salt 99.78 per cent; and the Leslie Velvet Grain California salt, 99.96 per cent.

Although the Manila salt (Malabon and Parañaque salts) contains less sodium chloride, its calcium content is very much less than that of the Ilocano salt.

The use of a much purer salt than the Manila or Ilocano salt is needed before any decided improvement in both the keeping quality and the flavor of the salted product can be expected.

CONCLUSIONS AND RECOMMENDATIONS

1. The center of the entire fishing activity of the southwestern coast of Samar is Catbalogan. It is an ideal site for an experimental station, its location being halfway between Manila and Zamboanga.

2. The experimental station needed is one similar to that proposed for Estancia—to conduct research on the problem of how

[3] Taylor, H. F., Principles involved in the preservation of fish by salt, appendix II, Report U. S. Commissioner of Fisheries for 1922, p. 8.

to improve the methods employed in the preservation of the large catches which cannot be utilized in the local fresh-fish market but could be disposed of in other markets in the cured or frozen state. In conjunction with this, extensive studies on the spawning habits and migrations of the common food fishes should be carried on.

3. The anchovy fishery is the most extensive. While measures are necessary for its protection and conservation, further studies on the life history of the species are needed before proper protective legislation can be formulated. Only by exhaustive research can it be determined when, where, and why the species needs protection. It is further recommended that a complete yearly statistical record of the catch be kept as a basis for the determination of depletion and inflation of the fisheries.

4. Opinions on the effect of fishing with light are varied. Some authorities claim that sea fishes as a rule are repelled by light, while in Japan and the Mediterranean it is employed in the catching of pelagic species such as anchovies, herrings, sardines, and mackerel, these being the fishes attracted by light. Its continuous employment in fishing will, no doubt, have some telling effect upon the abundance of these species as they are caught in great quantities within a short time, irrespective of size and age. On the other hand, since the anchovies are small it is only by the use of a fine-meshed net in connection with light that their capture can be successfully effected. It is, therefore, recommended that the use of such an outfit as the lawag and baring with light be confined to the catching of anchovies. For the protection of this fishery, various self-regulatory factors have been in operation, among which are the confinement of the fishing period to the dark of the moon; the operating expenses are excessively high so that when the catch is very small, fishing stops; finally, the taxation imposed upon this mode of fishing is almost prohibitive.

With regard to other species, such as the herrings, the sardines, and the mackerels that attain medium size and may be caught by gear other than the lawag and the baring, wholesale capture by the use of the above-mentioned nets should be prohibited.

Only by such compromise measures can the anchovy fisheries be exploited; otherwise they would remain untouched. These measures would at the same time effect the least destruction of the other pelagic species.

5. Certain sections of Maqueda (the northern) and Villareal Bays are trawlable. San Pedro Bay, which is more or less exposed, has a rugged bottom and is not, therefore, good for trawling (Plate 1). Only by the employment of such deep-sea fishing devices can the demersal resources of these seas be exploited; as yet, they are utilized only to a very limited extent.

6. While tracts of swamp lands, which are fringes along the shore, are favorable fishpond sites and while bangos fry could be obtained locally, the rearing of such fish on a commercial scale has very limited possibilities in a region where an abundance of marine species exists. In fact, such an enterprise should not be undertaken in localities where the market is very limited, for while sea fishes could be procured with the mere investment in catching facilities, the production of such a commodity in regularly constructed fishponds entails expenses that will tend to increase the selling price. Such items as the cost of constructing the pond, of the fry, and of marketing are expenses which must be taken into consideration. Added to this is the fact that the flavor of marine species is generally superior to that of any pond fish of the same species. The prevalence of typhoons and floods in this region also adds to the difficulty.

7. The fresh-water fishery in these regions is insignificant.

8. The fish-preservation methods could be improved by exercising proper care of the catch before it reaches the preservation plants; by the use of salt purer than the Manila or Ilocano salts, which will tend to increase the product's keeping quality and at the same time improve its flavor; by observing sanitary rules in the course of the preparation so as to exclude flies from the salted products and dirt and dust from the dried ones; and, finally, by the employment of containers other than boxes, cans, and sacks so as to avoid moisture during storage and in transit.

9. Inasmuch as the catch is more than the demand, attention should be given to the promising markets for fresh fish in big centers such as Cebu, Bohol, Iloilo, Zamboanga, and Manila by the employment of refrigeration. For the present, direct icing is employed in the Islands, although rapid freezing is the most recent method in vogue in foreign countries. Only fish in the best and freshest condition should be iced and shipped; hence they require the utmost care before they are refrigerated or iced. Eviscerated fish are the most profitable to market in this way.

10. Compared with the fees in other regions, the taxation imposed upon the privilege of fishing in southwestern Samar is excessive if not prohibitive. While this is the best means of guarding against overfishing, especially with regard to the lawag and the baring used in connection with light, it is recommended that a reduction in the fees of the other less-destructive gear that operate on a capital basis be adopted. It is also recommended that the fees on the gear that operate on a small scale, catches of which are just enough for home consumption, be abolished.

ILLUSTRATIONS

PLATE 1

Map of a part of Samar and of Leyte, showing the extent of the fishing grounds of the regions covered in the survey. (Reproduced from chart 4719 of the United States Coast and Geodetic Survey.)

PLATE 2

FIG. 1. Diving for shells and fish, Zumarraga.
2. Portion of the town of Zumarraga, a fishing region. Note a sapiao-an in the foreground.
3. A lawag outfit returning to Catbalogan after a night's fishing around the Canahauan Islands.

PLATE 3

FIG. 1. Close-up view of two sapiao-an of a lawag outfit, Zumarraga.
2. The semicircular inclosure of a deep-water bunuan being seined by the use of the siguin, Catbalogan.
3. A ligcop being hauled very close to the rocky shore, Barrio of Bioso, Zumarraga.

PLATE 4

FIG. 1. A conay or solambao, Basey.
2. A conay outfit in operation, Basey.
3. Unloading anchovies from the hold of the sapiao-an, Barrio of Mercedes, Catbalogan.

PLATE 5

FIG. 1. The catch of the bunuan being brailed out.
2. The catch of the ligcop being brailed out.
3. A pante hung to dry, Barrio of Salvacion, Basey.

PLATE 6

FIG. 1. Interior of a salting shed, Mercedes, Catbalogan.
2. Salting anchovies in the preparation of bagoong, Mercedes, Catbalogan.
3. The beach of Zumarraga, showing the platforms where fish are spread to dry in the sun.

PLATE 7

FIG. 1. Mercedes, Catbalogan, where the catch is preserved.
2. Entrance to the salting shed, Barrio of Guinsorongan, Catbalogan.
3. Fish being dried on elevated platforms at Mercedes, Catbalogan.

TEXT FIGURES

FIG. 1. Structure of the sapiao lawag; diagrammatic.
2. Inangcla bunuan without any pound or crib (deep water); diagrammatic.
3. Inangcla bunuan with two pounds or cribs on each side; diagrammatic.
4. Inangcla bunuan with two pounds or cribs on one side and a prolongation of the wing on the other; diagrammatic.
5. Inangcla bunuan with three pounds or cribs on one side only; diagrammatic.
6. Pangalato style of bunuan; diagrammatic.
7. Bunuan ordinario (shallow water); diagrammatic.
8. Structure of the baring; diagrammatic.

Calbayog
Sta. Margarita
Gandara
Napalisan I
Tarangnan
10 miles
Canahauan Is
CATBALOGAN
Wright
Maqueda B
SAMAR SEA
Daram
Buad I
Zumarraga
Villareal Bay
Calbiga
Villareal
Talalora
SAMAR
Sta. Rita
Janabatas Channel
CARIGARA BAY
SAN JUANICO STRAIT
Basey
Jinamoc
TACLOBAN
SAN PEDRO BAY
Carigara
LEYTE

PLATE 1.

1

2

3

PLATE 2.

1

2

3

PLATE 3.

1

2

3

PLATE 4.

1 2 3

PLATE 5.

1

2

3

PLATE 6.

1

2

3

PLATE 7.

A REVIEW OF PHILIPPINE MUGILIDÆ [1]

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TWO PLATES

Since 1907 a large amount of ichthyological material has been collected from different parts of the Philippines by various persons and deposited in the Government collections originally of the division of fisheries of the Bureau of Science, now transferred to the Fish and Game Administration of the Department of Agriculture and Commerce. A part of this collection has been worked out by Seale (1908), Herre (1923–1929), Herre and Montalban (1927–1930), Montalban (1927), and de Beaufort (1932).

The mullets are known as *aguas, balanak,* and *saranaa* in the Bicol provinces; as *lumitog, pasga, sisiao,* and *purong* in the Ilocano provinces; and *aligasin, talilong, banak,* and *balanak* in the Tagalog and Visayan provinces. They are mostly shore fishes feeding on algæ and other minute water plants contained in mud. They are encountered most often in bays with a more or less muddy bottom. They may be seen in schools of variable sizes and some species have the habit of jumping out of the water when surprised. Some of the Philippine mullets feed for the most part in ponds or lakes or upper portions of fresh-water streams and migrate to the sea only to spawn. Some mullets, however, are exclusively salt-water or brackish-water dwellers. The latter forms, it is believed, may, if tried, be amenable to culture much in the same manner as the *bañgos* (*Chanos chanos* Forskål).

MUGILIDÆ

The status of the various genera proposed under the family Mugilidæ is so uncertain that it is probably worth while to go over its literature. Cuvier and Valenciennes (1836) in the His-

[1] Contribution No. 7 from the Fish and Game Administration, Department of Agriculture and Commerce, Manila, P. I.

toire Naturelle des Poissons recognized four genera of Mugilidæ, as follows:

Mugil. With the edge of lower jaw angular.

Cestræus. With the edge of lower jaw rounded; mouth opening reaching up to level of hind edge of eye; lower jaw toothless.

Dajaus. With edge of lower jaw rounded; mouth opening reaching at most to level of front edge of eye; both jaws toothed.

Nestis. With edge of lower jaw rounded; mouth opening reaching to level of hind edge of eye; lower jaw toothless.

Günther (1861) united the three genera with rounded lower jaw and used an old name, *Agonostomus* of Bennett (1830) for the three of them, at the same time dividing the genus *Mugil* of Cuvier and Valenciennes into two: *Mugil,* with horizontal mouth cleft, and *Myxus,* with oblique mouth cleft. Thus his genera were—

Agonostomus. With rounded lower jaw margin.

Mugil. With angular lower jaw margin and horizontal mouth cleft.

Myxus. With angular lower jaw margin and oblique mouth cleft.

Weber and de Beaufort (1922) recognized both *Mugil* and *Myxus* of Günther, but used the name *Cestræus* of Cuvier and Valenciennes for all forms with rounded lower jaw margin. They, however, defined *Cestræus* in such a way as to include both *Nestis* and *Dajaus* of Cuvier and Valenciennes. *Agonostomus,* as originally used by Bennett, is equivalent only to *Nestis* Cuvier and Valenciennes so that *Agonostomus* of Bennett has to be considered as synonymous to *Cestræus* of Weber and de Beaufort. Mohr's suggestion (1927), therefore, to use all the three genera of Günther, cannot be followed.

Jordan and Swain (1884) attempted to solve the problem by stressing a variable character, the number of anal spines. Their genera were—

Querimana. With two anal spines.

Mugil. With three anal spines; mouth cleft, short, not lateral; lower jaw broad; "cilia" in one or few rows.

Chaenomugil. With three anal spines, mouth cleft lateral, lower jaw narrow, dentiform "cilia" in very numerous rows.

This division neglected to take into account a constant character, the kind of mouth formation, in the creation of the genus *Querimana.* Mohr (1927, pp. 197–200) has shown that all species described under this genus are young forms belonging to either *Mugil, Myxus,* or *Cestræus.* The word *Querimana* is now used to designate a young form of mullet with two anal spines.

Genus *Chænomugil* of Gill (1863) has for its type *Mugil proboscideus* Günther. An examination of Günther's figure (1861,

p. 460) shows that this animal has an oblique mouth cleft, thick fleshy upperlip, included mandible, and a cushion-like pad on the anterior edge of the lower jaw, and is thus a species of *Cestræus*. Genus *Chelon* of Röse (1793) with *Mugil chelo* Cuv. and Val. as type does not differ from *Mugil* and has to be considered as a synonym of the latter. The genus *Jotorus* of Poey (1861) possesses an angular lower jaw and a single series of teeth on the upper jaw, and, as such, must be considered as a synonym of the genus *Myxus*. For the same reason *Gonostomyxus* of Macdonald and *Xenorhynchthys* of Regan (1908) are also synonyms of *Myxus*.

The genus *Neomyxus* of Steindachner (1878) was separated from Günther's *Myxus* by the presence of two rows of teeth on both lips. These are smoothly compressed, three-pointed and with slender bases. The lower lip is also so placed that the teeth on it are directed outwards and downwards. I consider the genus *Neomyxus* valid.

The subgenus *Liza* of Jordan and Swain (1884) was based on the absence of an adipose eyelid. Inasmuch as many species described as belonging to *Liza* have the adipose eyelid developed to a certain degree, I am not following Oshima (1922) who has revived *Liza* as a genus.

I give here the genera that I consider valid, together with their synonyms:

1. MUGIL Linnæus (1758).

Albula Catesby (1771).
Cestræus Klein (1777), not Cuvier and Valenciennes.
Chelon Röse (1793).
Cephalus Lacépède (1803).
Mugil Cuvier and Valenciennes (1836).
Arnion Gistel (1848).
Mugil Günther (1861).
Rhinomugil Gill (1863).
Liza Jordan and Swain (1884).
Trachystoma Ogilby (1887).
Œdalechilus Fowler (1903).

2. CESTRÆUS Cuvier and Valenciennes (1836), neither Klein nor McClelland.

Agonostomus Bennett (1830).
Dajaus Cuvier and Valenciennes (1836).
Nestis Cuvier and Valenciennes (1836).
Chaenomugil Gill (1863).
Æschricthys Macleay (1863).
Agonostomus Günther (1869).
Cestræus Weber and de Beaufort (1922).

3. MYXUS Günther (1861).

Joturus Poey (1861).
Gonostomyxus Macdonald (1869).
Xenorhynchthys Regan (1908).

4. NEOMYXUS Steindachner (1878).

RECORD OF PHILIPPINE MUGILIDÆ

Jordan and Richardson (1910) in a check list of Philippine fishes credited the Philippine Islands with ten species of Mugilidæ, of which five belong to genus *Mugil*, four to *Liza*, and one to *Æschrichthys*. Almost simultaneously, Seale (1909) described two new species, *Mugil joloensis* and *Mugil banksi*, from the Philippines. Fowler recorded the existence of one species, *Liza labiosa* (1918) and described four new species of *Mugil* from Philippine waters (1918). Weber and de Beaufort (1922) brought up the number of known Philippine Mugilidæ to twenty by recording the presence of *Mugil subviridis*, *Mugil ceramensis*, and *Liza cæruleomaculatus*. To these Herre (1927) added one, *Liza melinopterus*, which he reported as present in Lake Taal, and Borodin (1930) another one, *Chaenomugil proboscideus* from Sindangan. Finally Herre (1931) recorded the presence of *Mugil seheli*, bringing the known Philippine mullets to twenty-three.

The following is a check list of the species of mullets so far reported from Philippine seas, lakes, and rivers.

Genus MUGIL Linnæus

1. MUGIL AMARULUS (Cuvier and Valenciennes).

Jordan and Seale (1906) as *Liza amarula*, Cavite; Seale and Bean (1907) as *Liza amarula*, Zamboanga.

2. MUGIL BANKSI Seale.

Seale (1909), Siquijor Island; Herre (1931), Okoi River, near Dumaguete.

3. MUGIL CÆRULEOMACULATUS (Lacépède).

Weber and de Beaufort (1922), Philippines.

4. MUGIL SEHELI (Forskål).

Herre (1931), Nasugbu, Lemery, Culion, Cebu, Dumaguete, as *Liza seheli*.

5. MUGIL CEPHALUS Cuvier and Valenciennes.

Kner (1865) as *M. cephalotus*, Manila; Jordan and Richardson (1907), Calayan; Weber and de Beaufort (1922), Philippines.

6. MUGIL CERAMENSIS (Bleeker).

Jordan and Seale (1906), Cavite; Weber and de Beaufort (1922), Philippines.

7. MUGIL DUSSUMIERI Cuvier and Valenciennes.

Evermann and Seale (1906) as *M. sundanensis*, Manila; Evermann and Seale (1906) as *M. sundanensis*, Bacon; Jordan and Seale (1906) as *M. sundanensis*, Cavite; Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, La Union; Laguna de Bay; Lake Bombon; Capag; Tayabas; Culion Islands; Cebu, Cebu; Dumaguete, Oriental Negros; Cotabato, Mindanao.

8. MUGIL ENGELI Bleeker.

Günther (1861) as *M. kelaarti*, Philippines; Günther (1876) as *M. kelaarti*, Philippines; Day (1889) as *M. kelaarti*, Philippines; Herre (1931), Nasugbu, Batangas; Unisan, Tayabas; Capiz, Capiz; Cotabato market, Cotabato, Mindanao.

9. MUGIL JOLOENSIS Seale.

Seale (1909), Jolo.

10. MUGIL LABIOSUS (Valenciennes).

Fowler (1918) as *Liza labiosa*, Philippines.

11. MUGIL LEPIDOPTERUS Fowler.

Fowler (1918), Philippines.

12. MUGIL LONGIMANUS Günther.

Jordan and Seale (1906), Cavite; Weber and de Beaufort (1922), Philippines; Fowler (1928), Philippines; Herre (1931), Manila; Nasugbu; Alabat Islands; La Paz, Iloilo Province.

13. MUGIL MELINOPTERUS (Cuvier and Valenciennes).

Herre (1927), Lake Taal (Bombon); Herre (1931), Polo Plantation, near Dumaguete; Jolo, as *Liza melinopterus*.

14. MUGIL OGILBY Fowler.

Fowler (1918), Philippines.

15. MUGIL OLIGOLEPIS (Bleeker).

Jordan and Richardson (1907), Iloilo; Weber and de Beaufort (1922), Philippines.

16. MUGIL PHILIPPINUS Fowler.

Fowler (1918), Philippines.

17. MUGIL RUTHVENI Fowler.

Fowler (1918), Philippines.

18. MUGIL SUBVIRIDIS Cuvier and Valenciennes.

Weber and de Beaufort (1922), Philippines.

19. MUGIL MACROLEPIS (Bleeker).

Evermann and Seale (1907), Manila; Jordan and Seale (1906), Cavite; Jordan and Richardson (1907), Lubang, Aparri, Iloilo; Seale and Bean (1907), Zamboanga, all as *Liza troscheli;* Fowler and Bean (1923) as *M. troscheli;* Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, Batangas Bay, Culion, Dumaguete, Jolo as *Liza troscheli.*

20. MUGIL TADE Forskål.

Evermann and Seale (1906) as *M. planiceps*, Bulan; Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, La Union Province.

21. MUGIL VAIGIENSIS (Quoy and Gaimard).

Jordan and Seale (1907), Cavite; Seale and Bean (1907), Zamboanga, both as *Liza waigiensis;* Fowler (1918), Philippines; Weber and de Beaufort (1922), Philippines; Herre (1931), Curimao, as *Liza vaigiensis.*

Genus CESTRÆUS Cuvier and Valenciennes

22. CESTRÆUS GOLDIEI (Macleay).

Jordan and Richardson (1907) as *Æschrichthys goldiei*, Mindoro; Weber and de Beaufort (1922), Philippines.

23. CESTRÆUS PROBOSCIDEUS (Günther).

Borodin (1930) as *Chaenomugil proboscideus*, Sindangan.

In addition to the above species this paper records *Mugil crenilabris* Forskål and *Cestræus oxyrhynchus* Cuvier and Valenciennes, from the Philippines. One new species, *Myxus philippinus*, is herein described.

The impression that *Mugil cephalus* is the commonest species in the Philippines is apparently wrong if our collection is used as a gauge of the relative abundance of the various species. In this collection there are only four examples of *M. cephalus*, one of which came from Honolulu and two from Hongkong. Although this species is of wide distribution, it is rarely met with in the Philippines. Weber and de Beaufort (1922) expressed surprise at the fact that although it is "known from so many localities in tropical and temperate seas all over the world," it is "very rare in the Archipelago" (Indo-Australian) "and with any certainty only represented in New Guinea and Borneo." Basing my conclusion on this collection, it appears that *Mugil dussumieri, Mugil longimanus,* and *Mugil cæruleomaculatus* are the commonest species in the Philippines.

Genus MUGIL Linnæus

Mouth cleft more or less transverse, with short lateral extension far distant from eye; mandible with angular front edge; no teeth on intermaxillary; upper lip with or without papillæ, sometimes with cilia on its lower edge; lower lip thin, may be fringed.

Key to the Philippine species of Mugil.

a^1. Adipose eyelid well developed, covering at least a third of the iris posteriorly; upper lip not particularly thick.

b^1. Anal with 9 soft fin rays.

c^1. Scales 28 to 31 in lateral series; maxillary exposed; anal ahead of second dorsal; pectorals shorter than head.

d^1. Snout equal to or shorter than eye; spinous dorsal origin midway between eye center or front edge of eye and caudal base; preorbital bent, scaly, emarginate, denticulate below and behind; maxillary does not reach below level of front edge of eye. *Mugil dussumieri* Cuvier and Valenciennes.

d^2. Snout greater than eye; spinous dorsal origin midway between snout tip and caudal base; lower edge of preorbital slightly convex and finely denticulate; maxillary reaches to below level of front edge of eye..... *Mugil lepidopterus* Fowler.

c^2. Scales 33 to 38 in lateral series.

d^1. Maxillary slightly visible; snout equal to or longer than eye; spinous dorsal origin much nearer to end of snout than to caudal base; first third of anal before origin of second dorsal, the origin of which is opposite the 21st to 23d lateral scale; pectorals much shorter than head; least height of caudal peduncle 1⅔ to 3 in head..... *Mugil tade* Forskål.

d^2. Maxillary hidden or nearly so; first dorsal origin about midway between end of snout and caudal base; least height of caudal peduncle more than twice in head.

e^1. Pectorals much shorter than head, reaching to 8th or 9th lateral scale ..... *Mugil engeli* Bleeker.

e^2. Pectorals about equal to head, reaching to 12th or 13th lateral scale; caudal peduncle almost twice in head; snout about equal to eye..... *Mugil longimanus* Günther.

b^2. Anal with 8 soft fin rays.

c^1. Maxillary not visible; lips with conspicuous yellow cilia; origin of first dorsal about midway between tip of snout and caudal base. *Mugil cephalus* Linnæus.

c^2. Maxillary exposed; origin of first dorsal nearer to caudal base than to tip of snout.

d^1. Snout shorter than eye; preorbital bent, denticulate at its inferior and subtruncate at its posterior border; no axillary scale above ventrals ..... *Mugil subviridis* Cuvier.

d^2. Snout equal to or longer than eye; preorbital not bent, with only few obsolete denticles; axillary scale present above ventrals.

e^1. Snout longer than eye; first dorsal spine longer than second; hind edge of caudal with dusky pigments. *Mugil ruthveni* Fowler.

e^2. Snout about equal to eye; first dorsal spine as long as second; no narrow dusky edge on caudal. *Mugil philippinus* Fowler.

a^2. Adipose eyelid poorly developed or wanting.
b^1. Upper lip not particularly thick.
c^1. Anal with 8 soft fin rays; maxillary not visible, or only extreme end visible; head very broad and flat; scales 27 to 28 in lateral series; pectorals blackish; other fins dusky at edge.
Mugil vaigiensis Quoy and Gaimard.
c^2. Anal with 9 soft fin rays.
d^1. Maxillary not visible, scales 26 to 33 in lateral series; origin of first dorsal nearer to caudal base than to snout tip.
e^1. Snout pointed; origin of second dorsal opposite the 21st lateral scale, nearly entirely behind anal.
Mugil ceramensis Bleeker.
e^2. Snout obtuse.
f^1. Scales 26 to 29 in lateral series; first half of anal before second dorsal.
g^1. Snout longer than eye; lower edge of preorbital slightly curved, with very few minute obsolete denticles, spinous dorsal origin between hind nostril and caudal base.
Mugil ogilby Fowler.
g^2. Snout shorter than eye.
h^1. Scales 26 in lateral series; rostro-dorsal profile convex; 15 to 16 predorsal scales; pectorals not much shorter than head, reaching near to origin of first dorsal; second dorsal origin opposite 17th lateral scale.
Mugil oligolepis Bleeker.
h^2. Scales 28 to 29 in lateral series; rostro-dorsal profile horizontal; 18 predorsal scales; pectorals much shorter than head and not reaching to level of first dorsal origin; second dorsal origin opposite the 18th or the 19th lateral scale.
Mugil melinopterus Cuvier and Valenciennes.
f^2. Scales 31 to 33 in lateral series; origin of second dorsal opposite the 21st to the 23d lateral scale and to first third of anal; pectorals shorter than head, without axillary scales ..... *Mugil macrolepis* A. Smith.
d^2. Maxillary hidden; scales 36 to 40 in lateral series; first dorsal origin about midway between caudal base and end of snout; anal and second dorsal almost at same level.
e^1. Scales 36 to 38 in lateral series; pectorals falcate, longer than head ..... *Mugil cæruleomaculatus* Lacépède.
e^2. Scales 38 to 40 in lateral series; pectorals shorter than head.
Mugil seheli Forskål.
b^2. Upper lip moderately or very thick; anals with 9 soft fin rays.
c^1. Upper lip without papillæ; end of maxillæ visible; snout obtuse; dorsal spines weak.
Mugil amarulus Cuvier and Valenciennes.
c^2. Upper lip provided with one or several rows of papillæ.
d^1. Upper lip with several rows of papillæ.
e^1. Lower lip fringed..... *Mugil crenilabris* Forskål.
e^2. Lower lip not fringed.

f^1. Preorbital with a very deep notch whose depth is greater than width of pupil..... *Mugil joloensis* Seale.

f^2. Preorbital without a distinct notch..... *Mugil banksi* Seale.

d^2. Upper lip with a single row of papillæ.

Mugil labiosus Cuvier and Valenciennes.

MUGIL DUSSUMIERI Cuvier and Valenciennes. Plate 1, fig. 2.

Mugil dussumieri CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 109; DAY, Fishes of India 4°. (1878–88) 352; MAX WEBER, Nova Guinea 5, Zool. Livr. 2 (1908) 243; Nova Guinea 9 (1913) 569; MCCULLOCH, Check-list Fishes N. S. Wales 2 (1919) 38; Rec. Austr. Mus. 13 (1921) 126; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 235; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 7; Mem. B. P. Bishop Mus. 10 (1928) 122.

Mugil sundanensis BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–1859) 276; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 425; BLEEKER, Act. Soc. Sc. Indo-Neerl. 8 (1860) 45; DAY, Fishes of Malabar (1865) 139; MACLEAY, Proc. Linn. Soc. N. S. Wales 7 (1882) 362; EVERMANN and SEALE, Proc. U. S. Nat. Mus. 31 (1906) 506; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 11; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 59.

Mugil javanicus BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1852) 701.

Mugil brachysoma BLEEKER, Nat. Tijdschr. Ned. Ind. 9 (1855) 399.

Mugil valenciennesii BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–1859) 277.

Mugil meyeri GÜNTHER, Ann. & Mag. Nat. Hist. IX 4 (1872) 439.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 30; scales in transverse series 10; head 4.1; depth 3.7; snout 5.6 in head; eye 3.7; maxillary 4.3, interorbital 2.5; 20 predorsal scales.

Rostro-dorsal profile almost straight, from neck to snout slightly declivous. Greatest width of head 1.5 in its length. Interorbital slightly convex. Snout convex, its length 2.4 in its width. Eye greater than snout, 1.5 in interorbital. Adipose eyelid greatly developed, the posterior covering almost all of iris. Upper lip not particularly thick with prominent, numerous cilia. Lower lip thin, mandibular rami coming together at an obtuse angle. Nostrils well separate, anterior circular, the posterior appearing as a transverse slit. Maxillary clearly visible. Preorbital scaly, slightly notched below and prominently dentate behind.

Spinous dorsal origin halfway between caudal base and front edge of eye. Second dorsal origin in front of level of middle of anal and opposite 20th lateral scale. Both soft dorsal and anal scaly. Least height of caudal 1.3 in its length and slightly less than postorbital part of head. Pectorals shorter than head,

equalling head less the snout; caudal emarginate. A short axillary at base of first dorsal and ventrals, but absent at base of pectorals.

The above description is based on No. 28353, obtained from Naujan Lake, Mindoro, August 1, 1927. Total length 11.25 inches.

LUZON, Pangasinan Province, Agno River, No. 657, 3.25 in. long, July 18, 1907; Alaminos, Nos. 24811–24812, 4 in. long, December, 1922: Pampanga Province, Guagua, Nos. 15342–15343, 7.5 in. long, April 8, 1927: Bulacan Province, Bulacan, No. 15265, 7 in. long, No. 15339, 5.5 in. long, No. 28319, 5 in. long, April 5, 1927: Manila, No. 6843, 9 in. long, June, 1910, No. 14263, 12.5 in. long, No. 28314, 12 in. long, August 20, 1926, No. 28342, 6 in. long, September 6, 1906; Paco Market, No. 41038, 7.5 in. long, July 14, 1913; Manila Bay, No. 41042, 7 in. long, October 30, 1929: Rizal Province, Montalban River, Nos. 28427–28430, 10 to 11 in. long, January 4, 1923; Pasig River, No. 28436–28437, 3 in. long, September, 1924: Bataan Province, Pilar, sitio Balat, No. 15538, 9 in. long, May 3, 1927: Batangas Province, Taal, Lake Bombon, No. 12568, 4 in. long, November 8, 1925; No. 15158, 10 in. long, April 8, 1927; Nos. 28317–28318, 4 in. long, November 8, 1925; Nos. 28323–28330, 3 to 6 in. long, April 8, 1927: Camarines Sur Province, Bicol River, No. 28404, 9 in. long, no date; Bicol River near Lake Bato, No. 11220, 10.5 in. long, September 23, 1924: Albay Province, Albay, Arimbay River, No. 13334, 7.5 in. long, February 6, 1926; Legaspi, sitio Puru, No. 13164, 4.75 in. long, February 4, 1924: Sorsogon Province, Bacon, No. 3644, 4 in. long, 1904. MINDORO, Mindoro Province, Naujan, Lake Naujan, Nos. 15424, 15430, 12 in. long, August 10, 1927, Nos. 28352–28353, 10 to 12 in. long, August 1, 1927; Butas, 28364–28365, 4.5 in. long, August 10, 1927; Puerto Galera Bay, No. 28474, 5 in. long, April, 1912. NEGROS, Oriental Negros Province, Dumaguete River, No. 28401, 5.5 in. long, March 8, 1922. SIBUYAN, Romblon Province, No. 28397, 3.5 in. long, July, 1913. PALAWAN, Palawan Province, Guinlo, No. 15292, 9 in. long, May 4, 1927. MINDANAO, Davao Province, Davao Gulf, Nos. 3149, 3196, 3.5 to 5 in. long, April 20 and 21, 1908.

MUGIL LEPIDOPTERUS Fowler.

Mugil lepidopterus FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 9.

Dorsal IV–I, 8; anal III, 9; scales in lateral series 30; scales in transverse series 10; head 4 in standard length, less than depth; depth 3.6; snout broad, convex, 3.5 in head, greater

than eye; eye 4; adipose eyelid well developed, the posterior extending over last third of eye; maxillary exposed, reaches to eye; interorbital broad, slightly convex, depressed medially, 2.17 in head; 20 predorsal scales.

Dorsal outline convex, broad, moderately elongate, deepest at level of spinous dorsal origin. Head robust, somewhat constricted below. Eye nearly impinges on upper profile. Mouth slightly inferior, mandibular angle obtuse, cilia on upper lip. Upper lip little fleshy, not thick, its width about half of pupil. Lower edge of preorbital slightly convex and finely denticulate.

Spinous dorsal origin midway between snout tip and caudal base. First and second spines subequal. Origin of soft dorsal opposite 19th lateral scale and opposite middle of anal. Caudal emarginate. Pectorals broad, shorter than head, reaching back to 5th or 6th lateral scale. Axillary scales at base of spinous dorsal, pectorals, and ventrals. Soft dorsal, caudal, and anal scaly for the greater extent.

This species differs from *M. dussumieri* in having the snout greater than the eye and in having the origin of spinous dorsal midway between the snout tip and the caudal base. Here also the maxillary reaches to below level of front edge of eye. It is not represented in our collection. The above description is based on that of Fowler (1918).

MUGIL TADE Forskål.

Mugil crenilabris tade Forskål, Descript. anim. (1775) xiv, 74.

Mugil tade Cuvier and Valenciennes, Hist. Nat. Poiss. 11 (1836) 114; Klunzinger, Abhandl. zool.-bot Ges. Wien 20 (1870) 828; Sitzungsb. Akad Wien (1880) 394; Fische des rothen Meeres (1884) 133; Macleay, Proc. Linn. Soc. N. S. Wales 9 (1884) 40; Day, Fishes of British India 2 (1889) 344; Weber and de Beaufort, Fish. Indo-Austr. Arch. 4 (1922) 236; Fowler, Mem. B. P. Bishop Mus. 10 (1928) 122.

Mugil cephalotus Cantor (not Cuvier and Valenciennes), Cat. Malayan Fish., Journ. Asiat. Soc. Bengal 18 pt. 2 (1850) 1077.

Mugil planiceps Bleeker, Verh. Bat. Gen. 25 (1853) 101; Günther, Cat. Brit. Mus. 3 (1859–61) 428; Kner, Fische Novara-Exp. (1865–67) 225; Day, Fishes of India 4°. (1878–1888) 350; Seale, Occ. Pap. B. P. Bishop Mus. 1 No. 3 (1901) 66; Evermann and Seale, Bull. U. S. Bur. Fish. 26 (1906) 59; Weber, Nova Guinea 9 pt. 4 (1913) 569.

Mugil bontah Bleeker, Verh. Bat. Gen. 25 (1853) 48; Nat. Tijdschr. Ned. Ind. 13 (1857) 336; 16 (1858–59) 278; 18 (1859) 367; Act. Soc. Sc. Indo-Neerl. 8 (1860) 49.

Mugil belanak Günther, Cat. Brit. Mus. 3 (1859–61) 427; Day, Fishes of India 4°. (1878–1888) 351; Fishes of British India 2 (1889) 345; Vinciguerra, Annal. Mus. Civ. Genova (2) 9 (1890) 180; Fowler,

Proc. Acad. Nat. Sci. 57 (1905) 455; WEBER, Nova Guinea 5 pt. 2 (1903) 244.

Mugil kandavensis GÜNTHER, Fische d. Südsee 2 (1876–1881) 215.

Dorsal IV–I, 8–9; anal III, 9; scales in longitudinal series 33–35; scales in transverse series 10–11; head 3.7–4 in standard length, depth 4.2–5.2; snout pointed, equal or longer than eye; eye 3–4.6 in head, with a posterior gelatinous eyelid covering about half of iris; maxillary visible; interorbital nearly flat, 1.5 to 2.5 times more than eye-diameter; preorbital emarginate, strongly curved, with inferior and posterior margin denticulate.

Rostro-dorsal profile nearly straight, declivous from crown to snout. Head anteriorly depressed and pointed. Origin of spinous dorsal nearer to tip of snout than to base of caudal, opposite 10th or 11th scale. Origin of second dorsal at level of anterior third of anal and opposite 21st to 23d lateral scale. Caudal slightly emarginate. Pectorals much shorter than head, reaching up to 8th lateral scale. Axillary scale at base of pectorals, very short; that on ventral about half of length of the fin.

This species has a greater scale count than *M. dussumieri* and differs from *M. engeli* in having a visible maxillary.

Evermann and Seale (1906) reported five specimens of this species as *M. planiceps*, 6.5 to 8.75 inches long, from Bulan, Sorsogon, none of which is in the collection. The above description is based on that of Weber and de Beaufort.

MUGIL ENGELI Bleeker. Plate 1, fig. 1.

Mugil engeli BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 277; Nat. Tijdschr. Ned. Ind. 15 (1858) 385; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 430; BLEEKER, Act. Soc. Sc. Indo-Neerl. 8 (1860) 78; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 122.

Mugil kelaarti GÜNTHER, Cat. Brit. Mus. 3 (1861) 429; Fische d. Südsee 2 (1876–81) 215; Rept. Voyage "Challenger" 1 (1880) 58; DAY, Fishes of India 4°. (1878–1888) 352; Fauna British India, Fishes 2 (1889) 346; FOWLER, Proc. Acad. Nat. Sci. 55 (1903) 743; Proc. Acad. Nat. Sci. 55 (1904) 743; SEALE, Occ. Papers B. P. Bishop Mus. 6 No. 1 (1906) 15; STEINDACHNER, Sitz. Akad. Wiss. Wien 115 pt. 1 (1906) 1416.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 34; scales in transverse series 10–11; head 4 in standard length; depth 4; snout 4.7 in length of head; eye 3.1 in head; maxillary 3.5; interorbital 2.1; 18 predorsal scales.

Dorsal profile almost straight, from neck to tip of snout declivous, slightly convex. Posterior region compressed, body becoming gradually thicker. Greatest thickness at region of oper-

cle, 1.4 in the length of head. Interorbital convex. Snout also convex, its length 1.8 in its width. Eye greater than snout, 1.4 in the interorbital. Adipose eyelid well developed, the anterior covering half of iris and the posterior covering two-thirds. Upper lip thin and smooth, without cilia. Lower lip also thin, the mandibular rami coming together at an obtuse angle. Nostrils far apart, the anterior close to border of snout, the posterior much closer to anterior border of eye than to anterior nostril. Maxillary hidden or nearly so. Preorbital slightly notched, finely denticulate anteriorly and ventrally.

Spinous dorsal origin slightly nearer to caudal base than to tip of snout. First dorsal spine about 1.6 in head. Second dorsal origin at level of anterior third of anal and opposite 21st lateral scale. Least height of caudal peduncle almost 1.5 in the length and 2.3 in the head. Caudal emarginate. Pectorals are a snout length shorter than head, the tip reaching back to 9th lateral scale. Axillary scale present at base of first dorsal, pectorals, and ventrals.

The above description is based on No. 5667 obtained from Bantayan Island, off Cebu, in April, 1909. Total length 5.5 inches.

This species differs from *M. longimanus* in having shorter pectorals and in having a shallower caudal peduncle.

LUZON, Rizal Province, Parañaque, No. 28398, 4.5 in. long, date unrecorded. MINDORO, Mindoro Province, Calapan, Nos. 11433, 28405, 5.5 in. long, January 17, 1923. BANTAYAN, Cebu Province, Bantayan, Nos. 5659, 5661–62, 5664–71, 5673–74, 5691, 28466, 5 to 5.5 in. long, April, 1909.

MUGIL LONGIMANUS Günther. Plate 1, fig. 3.

Mugil longimanus GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 428; STEINDACHNER, Denkschr. Akad. Wien 41 (1879) 5; MACLEAY, Proc. Linn. Soc. N. S. Wales 9 (1884) 41; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 10; OGILBY, Ann. Queensland Mus. 9 pt. 1 (1908) 26; MCCULLOCH, Rec. Austr. Mus. 13 No. 4 (1921) 130; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 239; FOWLER, Bull. B. P. Bishop Mus. 38 (1927) 9; Mem. B. P. Bishop Mus. 10 (1928) 123.

Mugil engeli DAY, Fishes of Malabar (1865) 139.

Mugil cunnesius DAY, Fishes of India (1873) 439; WAITE, Mem. N. S. Wales Nat. Club 2 (1904) 22.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 33–34; scales in transverse series 11; head 4.3 in standard length; height 3.4; snout 4.6 in head; eye 3.6; maxillary 4.2; interorbital 1.6; 18 predorsal scales.

Rostro-dorsal profile weakly convex, from neck to tip of snout convex, declivous. Greatest width of head 1.3 in its length. Interorbital convex. Snout declivous, its length 1.8 in its width. Eye greater than snout, 1.6 in interorbital. Adipose eyelid greatly developed, the posterior covering all of posterior iris. Upper lip not particularly thick, smooth, free from cilia. Mandible thin, mandibular rami meeting at an obtuse angle. Nostrils far apart, the posterior in the form of a transverse slit, the anterior much nearer to edge of snout than to front edge of eye. Maxillary completely hidden. Preorbital scaly, nearly straight or very weakly emarginate, denticulate anteriorly and ventrally.

Spinous dorsal origin about halfway between snout tip and caudal base, opposite 11th lateral scale. First dorsal spine 2.7 in head. Second dorsal origin opposite anterior third of anal, and the 21st lateral scale. Least height of caudal 1.25 in its length and equal to postorbital part of head. Caudal emarginate. Pectorals equal to head, the tip reaching to 11th or 12th lateral scale and to level of first dorsal origin. Long axillary scales present at base of first dorsal, pectorals, and ventrals. No particular distinctive mark.

The above description is based on No. 10445 taken from Bato, Leyte, in December, 1922. Total length 7.25 inches.

This species is close to *Mugil engeli*, but has longer pectorals and a deeper caudal peduncle.

LUZON, Pangasinan Province, Agno River, No. 659; 5 in. long, July 18, 1907: Zambales Province, Subic, Nos. 12017, 28413, 4 in. long, February 20, 1925: Pampanga Province, Guagua, No. 15341, 4.5 in. long, April 8, 1927: Rizal Province, Malabon, Nos. 715, 717, 28392, 4 to 5 in. long, July 18, 1907; Parañaque, Nos. 28348–51, 5.5 in. long, July 21, 1908. MINDORO, Mindoro Province, Mangarin, Nos. 28344–45, 4.5 in. long, 1913. LEYTE, Leyte Province, Bato, Nos. 10445, 28410, 28419, 8 and 6.5 in. long, December, 1922; Carigara, Nos. 15061 and 28403, 6.5 in. long, December 1, 1926. PANAY, Iloilo Province, Iloilo, No. 28402, 6 in. long, July 19, 1922. GUIMARAS, Iloilo Province, Guimaras Strait, No. 10996, 4 in. long, May, 1922. MINDANAO, Misamis Province, Cagayan, Nos. 1448, 1467, 1524, 1550, 1753–54, 5 in. long, September 8, 1907: Agusan Province, Agusan River, Nos. 1809, 1811, 5 in. long, September, 1907: Davao Province, Davao, Nos. 3150, 3152, 3162, 4.75 to 5 in. long, April 20, 1908.

MUGIL CEPHALUS Linnæus. Plate 1, fig. 5.

Mugil cephalus Linnæus, Syst. Nat. ed. 10a (1758) 316; Hamilton-Buchanan, Gangetic Fish (1822) 119; Evermann and Jenkins, Proc. U. S. Nat. Mus. 16 (1892) 136; Jordan and Evermann, Fish. North and Middle America 1 (1896) 811; Fowler, Proc. Acad. Nat. Sci. 55 (1903) 743; Jenkins, Bull. U. S. Fish. Comm. 22 (1904) 438; Jordan and Evermann, Bull. U. S. Fish. Comm. 23 (1905) 139; Jordan and Seale, Proc. U. S. Nat. Mus. 29 (1905) 521; Jordan and Richardson, Bull. U. S. Bur. Fish. 27 (1907) 244; Tanaka, Fishes of Japan 3 (1911) 50; Fowler, Proc. Acad. Nat. Sci. 67 (1915) 248; McCulloch, Check-list of Fishes of N. S. Wales 2 (1919) 38; Weber and de Beaufort, Fish. Indo-Austr. Arch. 4 (1922) 253; Fowler, Mem. B. P. Bishop Mus. 10 (1928) 125.

Mugil öur Forskål, Descr. anim. (1775) 74; Rüppell, Neue Wirbelthiere (1835–1840) 131; Jordan and Snyder, Proc. U. S. Nat. Mus. 23 (1901) 744.

Mugil cephalotus Cuvier and Valenciennes, Hist. Nat. d. Poissons 11 (1836) 110; Eydoux and Souleyet, Voy. de la "Bonite" (1841) 175; Bleeker, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 277; Act. Soc. Sc. Indo. Neerl. 8 (1860) 51; Kner, Novara-Exp. Fische 1 (1865) 224; Günther, Ann. & Mag. Nat. Hist. 20 (1867) 64; Bleeker, Ned. Tijdschr. Dierk. 4 (1873) 100, 143; Poissons de Madagascar (1875) 45; Verh. Akad. Amsterdam 18 (1879) 2; Günther, "Challenger" Rept. 6 (1880) 33; Nystrom, Bihang K. Sv. Vet. Akad. Handl. 8, Ajd. 4, No. 4 (1887) 38; Sauvage, Poiss. Madagascar (1891) 402.

Mugil japonicus Schlegel, Fauna Japonica (1845) 134; Bleeker, Verh. Bat. Gen. 25 (1853) 41; Ned. Tijdschr. Dierk 4 (1873) 143; Verh. Akad. Amsterdam 18 (1879) 17.

Mugil macrolepidotus Richardson, Ichth. Seas of China and Japan (1846) 249.

Mugil dobula Günther, Cat. Brit. Mus. 3 (1859–61) 420; Fische d. Südsee 2 (1876–81) 214; Steindachner, Denkschr. Akad. Wien 70 (1900) 501.

Mugil oeur Klunzinger, Abhandl. zool.-bot. Ges. Wien 20 (1870) 829; Day, Fishes of India, 4°. (1878–1888) 353; Klunzinger, Fische d. Rothen Meeres (1884) 132; Steindachner and Doderlein, Fische Japans 4, Denkschr. Akad. Wien 53 (1887) 266; Day, Fishes of British India 2 (1889) 348; Rutter, Proc. Acad. Nat. Sci. Phila. (1897) 70; Jordan and Evermann, Proc. U. S. Nat. Mus. 25 (1902) 332.

Mugil hypselosonia Ogilby, Proc. Linn. Soc. N. S. Wales 22 (1897) 74.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 37–40; scales in transverse series 14–15; depth less than head, 4.5–4.7; snout shorter than eye; eye about 4 in head; maxillary not visi-

ble; interorbital nearly flat, much broader than eye; 20 to 22 predorsal scales.

Origin of first dorsal midway between end of snout and base of caudal, or slightly nearer snout tip, opposite 11th to 12th lateral scale. Origin of second dorsal opposite 23d to 25th lateral scale and slightly behind that of anal. Pectoral acute, much shorter than head, reaching to about 9th or 10th lateral scale. Caudal deeply emarginate, the upper lobe the longer. Least height of caudal peduncle 2.25 to 2.33 in the head.

This is represented in the collection by only one specimen, No. 28426, 17 inches long, from Ilocos Sur Province, Luzon; the exact locality and date were not recorded. There are, however, three foreign specimens in the collection, No. 7470 from Honolulu, and Nos. 6280 and 6285 from Hongkong, China.

MUGIL SUBVIRIDIS Cuvier and Valenciennes.

Mugil subviridis CUVIER and VALENCIENNES, Hist. Nat. Poiss. 11 (1836) 115; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 423; DAY, Fishes of Malabar (1865) 64; Fishes of India 4°. (1889) 348; DE BEAUFORT, Bijdr. tot de Dierk. Afl. 19, Amsterdam (1913) 107; MAX WEBER, Siboga-Expeditie, Fische (1913) 138; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 243.

Mugil alcocki OGILBY, Ann. Queensland Mus. 9 pt. 1 (1908) 21.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 28–30; scales in transverse series 11–12; head 4 in standard length; depth equal to or sometimes slightly more than head; snout shorter than eye, broad, somewhat depressed; eye 3.5–4 in head, with well developed adipose eyelid; maxillary visible; interorbital nearly flat about 2.5 in head, preorbital angularly bent, denticulate at its anterior and somewhat truncate at its ventral border.

Rostro-dorsal profile nearly straight. First dorsal origin nearer to caudal base than to end of snout, opposite the 10th or 11th lateral scale. Dorsal spines, strong, heteracanth. Second dorsal origin behind the first third of anal and opposite the 19th or 20th lateral scale. Pectorals shorter than head, reaching 7th or 8th lateral scale. Caudal broad, emarginate, and like the second dorsal and anal thickly scaled. No axillary scale above pectorals and ventral.

The above description is based on that of Weber and de Beaufort (1922) who reported this species from the Philippines.

This species differs from *M. cephalus* in having the maxillary exposed and the spinous dorsal nearer the caudal base than to tip of snout. Unlike *M. ruthveni* and *M. philippinus*, this spe-

cies has the snout shorter than the eye. It is not represented in the collection.

MUGIL RUTHVENI Fowler.

Mugil ruthveni FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 3.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 30; scales in transverse series 11; head equals depth, 3.7 in standard length; snout 3.8 moderately broad, greater than eye; eye 4.5; adipose eyelid well developed, the posterior extending over last third of eye; maxillary exposed, not quite to eye; interorbital 2.4, broadly convex; 20 predorsal scales.

Body fusiform, compressed, deepest at level of spinous dorsal. Head robust, snout convex as viewed above, with length 2 in its width. Mouth slightly inferior, mandibular angle obtuse, cilia on upper jaw. Upper lip rather fleshy, with width about half of pupil. Lower edge of preorbital straight with minute denticles.

Spinous dorsal origin midway between front edge of eye and caudal base. First spine longer and stronger than second. Soft dorsal origin behind middle of anal and opposite 22d or 23d lateral scale. Caudal emarginate. Pectorals broad and short reaching 9th lateral scale. Axillary at base of pectoral short.

This species is similar in many ways to *M. dussumieri,* but the snout is greater than the eye and there are eight instead of nine anal spines. It is not represented in the collection. The above description is based on that of Fowler (1918).

MUGIL PHILIPINUS Fowler.

Mugil philippinus FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 7.

Dorsal IV–I, 8; anal II, 8; scales in longitudinal series 30; scales in transverse series 10; head equals depth; 3.8 in standard length; snout broad, widely convex as viewed above, equals eye; eye 4; adipose eyelid well developed, the posterior extending over last third of iris; maxillary exposed, almost reaching eye; interorbital broadly convex, 2.3; 19 predorsal scales.

Dorsal profile convex; head robust, mouth somewhat inferior, mandibular angle very broad and obtuse; cilia on upper jaw. Upper lip somewhat fleshy, not thick. Lower edge of preorbital straight, not notched, with few obsolete denticles.

Origin of spinous dorsal midway between front edge of eye and caudal base, first spine about as long as the second. Origin of second dorsal slightly behind that of anal, opposite 20th to 21st lateral scale. Caudal emarginate. Pectorals broad, shorter

than head, reaching to 8th or 9th lateral scale. Axillary present at base of first dorsal, ventrals, and pectorals. Soft dorsal, caudal, and anal scaly for the greatest extent.

This differs from *M. ruthveni* in having the snout equal to eye, in having the first dorsal spine as long as the second and in not having the edge of the caudal dusky. It is not represented in the present collection. The above description is based on that of Fowler (1918).

MUGIL VAIGIENSIS Quoy and Gaimard. Plate 1, fig. 12.

Mugil vaigiensis QUOY and GAIMARD, Voyage "Uranie" (1925) 337; BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 276; Akad. Vet. Amsterdam, Verslagen, 2d ser. 2 (1868) 300; DE BEAUFORT, Bijdr. tot de Dierk. Afl. 19 Amsterdam (1913) 107; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 244; DUNCKER and MOHR., Mitt. Zool. Mus. Hamburg 42 (1926) 131; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 124.

Mugil waigiensis PETERS, Akad. Wiss. Berlin, Monatsb. 1876 (1877) 842; GÜNTHER, Cat. Brit. Mus. 3 (1859) 435; DAY, Fishes of Malabar (1865) 144; KNER, Fische Novara-Exp. 1 (1865–67) 226; KLUNZINGER, Abh. zool-bot. Gesellsch. Wien 20 (1870) 825; MACLEAY, Proc. Linn. Soc. N. S. Wales 7 (1882) 362; KLUNZINGER, Fische d. Südsee 2 (1876–81) 216; DAY, Fishes of India 4°. (1878–88) 359; SAUVAGE, Hist. Nat. d. Poiss. de Madagascar (1891) 401; SEALE, Occ. Pap. B. P. Bishop Mus. 1 (1901) 65; STEINDACHNER, Sitz. Akad. Wiss. Wien. 115 (1906) 1416; MCCULLOCH, Checklist of the Fish and Fish-like Animals of N. S. Wales pt. 2 (1919) 38.

Liza vaigiensis KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 257; FOWLER, Copeia No. 58 (June, 1918) 62.

Liza vaigiensis SEALE, Occ. Pap. B. P. Bishop Mus. 4 (1906) 15; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 11; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 240.

Mugil macrolepidotus RÜPPELL, Atlas Fische d. Rothen Meeres (1928) 140; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 11 (1836) 99; BLEEKER, Nat. and Geneesk. Arch. Ned. Indie (3) 2 (1845) 514; CANTOR, Cat. Malay. Fishes, Journ. Asiatic Soc. Bengal 17 (1850) 1077; Journ. Soc. Cherbourg. Mem. 8 (1861) 316.

Mugil melanochir CUVIER and VALENCIENNES, Hist. Nat. Poiss. 11 (1836) 106; BLEEKER, Verh. Bat. Genootsch. 22 (1849) 5; Nat. Tijdschr. Ned. Ind. 3 (1852) 432.

Mugil tegobuan THOILLIERE, Fauna Woodlark (1857) 184.

Mugil rossii BLEEKER, Nat. Tijdschr. Ned. Ind. 7 (1854) 45; MAX WEBER, Siboga-Exp. Fische (1913) 138.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 24–26; scales in transverse series 9; head 4; height 3.7; snout 4.2 in head; eye 4 in head; maxillary 4; interorbital 1.6; 15 predorsal scales.

Rostro-dorsal profile straight. Body rather stout, compressed posteriorly but very wide anteriorly. Greatest width of head equal to its length less the snout. Interorbital almost flat. Snout almost flat dorsally, its length 2.7 in its width. Eyes greater than snout, 2.6 in interorbital. Adipose eyelid wanting. Upper lip thin, with fine ciliary teeth. Mandibular rami meet at an obtuse angle. Nostrils well separated, the posterior slightly wider. Maxillary visible at tip. Preorbital only slightly bent, finely denticulate anteriorly and ventrally.

Spinous dorsal origin between caudal base and posterior edge of eye. Second dorsal origin opposite 18th scale and slightly behind middle of anal. Least height of caudal peduncle about equal to its length and postorbital part of head. Caudal almost truncate or only slightly emarginate. Pectoral shorter than head, its tip reaching the 8th scale, and two scales distant ahead of spinous dorsal origin. Axillary present on pectorals.

Pectorals blackish and edges of all other fins dark.

The above description is based on No. 28432, 13 inches total length, from Cabalian, Leyte Province, collected in December, 1922.

LUZON, Bulacan Province, Paombong, No. 15340, 5 in. long, April 22, 1927. MINDORO, Mindoro Province, Puerto Galera, Nos. 7159, 28360, 28394–96, 3 in. long, 1912; Calapan, No. 12349, 5 in. long, February, 1925. LEYTE, Leyte Province, Cabalian, Nos. 28431–32, 12 in. long, December, 1922. PANAY, Capiz Province, Panay, No. 15479, 17.5 in. long, August 19, 1927. BUSUANGA, Palawan Province, Busuanga, Nos. 2053, 4965, 28354, 1.5 in. long, October, 1907. PALAWAN, Palawan Province, Puerto Princesa, No. 5383, 1.5 in. long, August, 1908; Guinlo, No. 15495, 5 in. long, May, 1927. BALABAC, Palawan Province, No. 5114, 1.5 in. long, October, 1907. LUMBUCAN, Palawan Province, Lumbucan, Nos. 15681, 28470–71, 3 in. long, November, 1927. MINDANAO, Zamboanga Province, Zamboanga, Nos. 10411, 28400, 7 in. long, March, 1923. TUBIGAN, Sulu Province, Tubigan, No. 28408, 2.5 in. long, March, 1916. SIBUTU, Sulu Province, Sibutu, No. 14119, 2.5 in. long, April, 1926. Borneo, North Borneo, Sandakan, No. 14172, 8.5 in. long, November 21, 1925.

MUGIL CERAMENSIS Bleeker. Plate 11, fig. 3.

Mugil ceramensis BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 699; Nat. Tijdschr. Ned. Ind. 16 (1858–1859) 277; Act. Soc. Sc. Indo. Neerl. 8 (1860) 48; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 449; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 11.

Dorsal IV–I, 8–9; anal III, 9; scales in longitudinal series 30–31; scales in transverse series 10–11; head 3.7 in length; depth slightly greater than head; snout acute, about equal to eye; eye 3.8 to 4 in head. Adipose eyelid poorly developed; maxillary exposed, interorbital flat or slightly convex, over twice in head; 18–19 predorsal scales.

Rostro-dorsal profile evenly descending and straight, head pointed and nearly straight. Snout acute. Preorbital slightly bent and strongly denticulate at its lower and posterior border. Origin of first dorsal much nearer to caudal base than to tip of snout. First dorsal spine longer and stronger. Origin of second dorsal almost behind anal, opposite 19th or 20th lateral scale. Pectorals shorter than head, reaching to about 7th lateral scale provided with an axillary scale.

This species is easily recognized through its pointed, nearly straight head, through the characteristic position of the second dorsal which is almost entirely behind anal and through the heavy denticulation on the anterior as well as ventral sides of the preorbital.

Six specimens of this species were reported by Jordan and Seale from Cavite in 1906. It is represented in the collection by one specimen only, No. 11530, collected from Malampaya Sound, Palawan, in 1922. Total length 8.25 inches.

MUGIL OGILBY Fowler.

Mugil ogilby FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 5.

Dorsal IV–I, 8; anal III, 9; scales in lateral line 28; scales in transverse series 10; head slightly less than depth, 3.9 in standard length; depth 3.7; snout broad, widely convex, about 3.7 in head; eye 4.5; adipose eyelid little developed, the posterior extending over last fifth of eye; maxillary exposed, about to eye; interorbital broadly convex 2.25 in head; 20 predorsal scales.

Body elongate, contour fusiform, lower profile slightly more convex, deepest at level of spinous dorsal origin. Head robust, lower profile slightly more convex. Mouth little inferior, mandibular angle obtuse; cilia minute. Upper lip rather fleshy, its width about four-sevenths of pupil. Lower edge of premaxillary slightly curved with very few minute, obsolete, denticles.

Spinous dorsal origin midway between hind nostril and caudal base. First spine slightly longer, but second slightly larger. Second dorsal origin opposite middle of anal and at level of 20th lateral scale. Caudal slightly emarginate. Pectorals broad, shorter than head, reaching 7th lateral scale. Axillary scales

at base of first dorsal and ventral moderate in length; those on pectorals short. Caudal, second dorsal, and anal scaly for the most part.

This differs from all other species of *Mugil* with poorly developed adipose eyelid and with obtuse snout, in having the snout greater than the eye. It is not represented in the collection. The above description is based on that of Fowler (1918).

MUGIL OLIGOLEPIS Bleeker.

Mugil macrolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 422. (Name preoccupied.)

Mugil oligolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 19 (1859) 437; Act. Soc. Sc. Ind. Neerl. 8 (1860) 40; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 449; DAY, Fishes of India 4°. (1878–1888) 358; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 244; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 245.

Liza oligolepis FOWLER, Proc. Acad. Nat. Sci. 57 (1905–06) 497.

Dorsal IV–I, 8–9; anal III, 9: scales in longitudinal series 26; scales in transverse series 10–11; head 3.4 in length; depth somewhat less than head; snout blunt, shorter than eye; eye 3.5 in head; adipose eyelid wanting; maxillary exposed; interorbital slightly convex, much broader than eye and less than postorbital part of head; 15 or 16 predorsal scales.

Rostro-dorsal profile convex. Preorbital bent, emarginate with a truncate, denticulate, inferior border. First dorsal with strong spines, with origin nearer caudal base than tip of snout, opposite 9th lateral scale. Origin of second dorsal behind anterior half of anal and opposite 17th or 18th scale. Pectorals not much shorter than head, reaching almost to level of first dorsal origin.

This species differs from *Mugil ogilby* Fowler in having the snout shorter than the eye and from *Mugil melinopterus* in having fewer scales. It has been reported by Jordan and Richardson from the Philippines, but it is not represented in our collection.

MUGIL MELINOPTERUS Cuvier and Valenciennes. Plate 1, fig. 7.

Mugil melinopterus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 146; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 452; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 246; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Mugil melanopterus GÜNTHER, Fische d. Südsee 2 (1876–81) 218.

Liza melinopterus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1905) 1906, 217; HERRE, Philip. Journ. Sci. 34 (1927) 294, 296.

Liza melinoptera JORDAN and DICKERSON, Proc. U. S. Nat. Mus. 34 (1908) 607; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 256.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 28–29; scales in transverse series 10–11; head 4; height 3.5; snout 5.3 in head; eye 4 in head; maxillary 4.5; interorbital 2; predorsal scales 20.

Rostro-dorsal profile almost straight, slightly convex anteriorly. Body compressed posteriorly becoming wider anteriorly. Greatest width of head equals its length less the snout. Interorbital slightly convex. Snout broadly convex, its length 2.7 in its width. Eye greater than snout, 2.08 in interorbital. Adipose eyelid poorly developed, appearing as a narrow rim on the posterior side. Upper lip thin with a groove for reception of symphysial knob. Mandibular rami meet at an obtuse angle. Minute cilia on upper jaw. Maxillary visible. Preorbital weakly emarginate with fine dentition on anterior and ventral edges.

Spinous dorsal origin midway between front edge of eye and caudal base. Origin of second dorsal opposite 19th scale, and opposite middle of anal. Pectorals shorter than head with tip reaching up to 8th scale and two scales distant ahead of spinous dorsal origin. Least height of caudal peduncle 1.2 in its length and equal to postorbital part of head. Caudal deeply emarginate. Axillary present at base of first dorsal and ventral but absent on pectoral.

The above description is based on No. 532, obtained from Manila Market, July 10, 1927, 10.5 inches long.

Fowler (1928) has united this species with *M. vaigiensis*, although it lacks the typical black fins of *M. vaigiensis*. It also differs from *M. vaigiensis* in having nine anal rays, a narrower and more convex interorbital, and a slightly more-developed adipose eyelid. *Mugil melinopterus* does not reach as great a size as *M. vaigiensis*.

LUZON, Ilocos Norte Province, Bangui, Nos. 14325, 28409, 3.5 to 4 in. long, August 19, 1926. MINDANAO, Misamis Province, Cagayan, Nos. 1468, 1496, 1511–13, 2 to 5 in. long, September 9, 1907: Davao Province, Davao, No. 3245, 4 in. long, April 22, 1908, Samal, No. 3711, 6.5 in. long, May, 1908: Zamboanga Province, Zamboanga, No. 2982, 4.5 in. long, April 13, 1908. SIMONOR, Sulu Province, Simonor, Nos. 10748, 28407, 3.5 in. long, September, 1923.

MUGIL MACROLEPIS A. Smith. Plate 1, fig. 6.

Mugil macrolepis A. SMITH, Ill. Zool. S. Af. IV (1849) pl. 28, fig. 2 (no pagination); FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 124.

Mugil adustus BLEEKER, Nat. Tijdschr. Ned. Ind. 5 (1853) 503.

Mugil borneensis BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 278; KNER, Reise "Novara" Fische 1 (1865) 5, 228; GÜNTHER, Fische d. Südsee 2 (1876–81) 218; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 249.

Liza borneensis KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 258.

Mugil troschelii BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 277; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 448; SCHMELTZ, Cat. Mus. Godeffroy 4 (1869) 21; MACLEAY, Proc. Linn. Soc. N. S. Wales 7 (1882) 362; DAY, Fishes of India 4°. (1878–1888) 358.

Mugil troscheli BLEEKER, Act. Soc. Sci. Indo-Neerl. 8 (1860) 80; WEBER, Nova Guinea 9 pt. 4 (1913) 569; REGAN, Proc. Zool. Soc. London 20 pt. 6 (1914) 276; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 248; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Liza troscheli JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1905) 217; Bull. U. S. Fish. 26 (1906) 11; EVERMANN and SEALE, Proc. U. S. Nat. Mus. 31 (1906) 506; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 244; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 240; JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 332; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 256.

Mugil compressus GÜNTHER, Fische d. Südsee 2 (1876–81) 217; MACLEAY, Proc. Linn. Soc. N. S. Wales (1883) 269.

Liza compressa KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 256.

Mugil rechingeri STEINDACHNER, Sitz. Akad. Wiss. Wien 115 pt. 1 (1906) 1416.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 31–32; scales in transverse series 11; head 4.2 in standard length; depth 3.8; snout 4.5 in head; eyes 3.4; maxillary 3.5; interorbital 2; 19 or 20 predorsal scales.

Dorsal profile slightly convex, from first dorsal to snout slightly declivous, snout depressed, broadly convex. Head width 1.4 in its length. Eye greater than snout, 1.7 in interorbital space, its center at anterior third of head. Adipose eyelid poorly developed, only as a narrow edge around orbit. Upper lip thin, with very minute cilia. Rami of mandibles coming together at an obtuse angle. Maxillary visible. Preorbital slightly emarginate, rounded below and finely denticulate anteriorly and ventrally. Spinous dorsal origin midway between caudal base and front edge of eye. Second dorsal origin at level of anterior third

of anal and opposite 22d scale. Least height of caudal peduncle 1.4 in its length and equal to postorbital part of head. Pectorals short, equal to head without snout, reaching 9th scale and about two scales ahead of spinous dorsal origin. Very long axillary scales at base of first dorsal and ventrals, but absent at pectorals.

The above description is based on No. 9048 collected from Mangarin, Mindoro, in June, 1913. Total length 10 inches.

LUZON, Abra Province, Bangued, No. 10446, 12.5 in. long; June 7, 1923: Rizal Province, Malabon, No. 15296, 9.5 in. long, March 31, 1927: Batangas Province, Pansipit River, No. 12961, 9.5 in. long, January 10, 1926. MINDORO, Mindoro Province, Puerto Galera, Nos. 28450–53, 5 to 8 in. long, May, 1912; Mangarin, No. 9648, 9.75 in. long, 1913. MASBATE, Masbate Province, Guinobatan, No. 1076, 3.5 in. long, August 31, 1907. SIQUIJOR, Oriental Negros Province, Lazi, Nos. 1365–67, 1413–14, 3.5 to 5 in. long, September 6, 1907. MINDANAO, Misamis Province, Gingoog, Nos. 15050, 28406, 5 to 5.5 in. long, February 20, 1927: Zamboanga Province, Dapitan, No. 15051, 7.5 in. long, March 14, 1923. BUNGAU, Sulu Province, Bungau, Nos. 10455, 28454–65, 2.5 in. long, September 7, 1926.

MUGIL CÆRULEOMACULATUS Lacépède. Plate 1, fig. 8.

Mugil cæruleomaculatus LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 385, 389; CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 128; BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 484; Nat. Tijdschr. Ned. Ind. 16 (1858–59) 279; Act. Soc. Sc. Indo-Neerl. 8 (1860) 5; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 445; SAUVAGE, Hist. Nat. d. Poissons de Madagascar (1891) 398; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 250.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 36–38; scales in transverse series 12 or 13; head 4–4.4 in standard length; height 3.6–4.2; snout 4.5–4.8; maxillary 4.3, interorbital 2; 20–22 predorsal scales.

Rostro-dorsal profile slightly convex, from second dorsal to neck almost straight, slightly declivous; greatest width of head 1.4 in length. Interorbital convex; snout convex, declivous, its length 2.2 to 2.5 in its width. Eye greater than snout, 2.2 in interorbital. Adipose eyelid wanting or very poorly developed as a very narrow edge around orbit. Upper lip thin, smooth or with few fine cilia. Mandibular rami come together in an obtuse angle. Maxillary entirely hidden. Preorbital scaly, almost straight, finely denticulate anteriorly and ventrally.

Origin of first dorsal midway between snout tip and caudal base. Second dorsal at same level as, or very slightly behind, anal, and opposite the 23d to 24th lateral scale. Least height of caudal peduncle about its length, and equal to or very slightly greater than postorbital part of head. Caudal very strongly forked. Pectorals falcate much longer than head, their tip reaching 12th to 14th lateral scale. Long axillaries present at base of pectorals, first dorsal and ventrals.

Pectorals distinctly yellowish with a black spot at base.

The above description is based on No. 28321, collected June 25, 1927, from Obando, Bulacan. Total length 9.25 inches.

LUZON, Bulacan Province, Paombong, Nos. 15237, 28313, 6.5 in. long, April 22, 1927; Obando, Nos. 15319, 28320, 28322, 8 to 9 in. long, June 25, 1927: Manila, Manila Market, Nos. 320, 5 in. long, June 17, 1927; Manila Market, No. 41043, 15.5 in. long, December 14, 1930; Manila Bay, No. 41041, 6 in. long, October, 1929. MINDORO, Mindoro Province, Mangarin, No. 28346, 8.5 in. long, 1913. CULION, Palawan Province, Culion, No. 28343, 5.5 in. long, April 20, 1908. PANAY, Capiz Province, Capiz, No. 1574, 13 in. long, August 16, 1927; Estancia, Nos. 10865–66, 6.5 to 7.5 in. long, July, 1922. NEGROS, Oriental Negros Province, Polo, Polo Plantation, No. 154437, 5 in. long, August 21, 1927. MINDANAO, Misamis Province, Cagayan, Buguey, Nos. 12849, 28399, 4.5 to 5 in. long, December 6, 1925.

MUGIL SEHELI Forskål. Plate 1, fig. 10.

Mugil crenilabris seheli FORSKÅL, Descr. Anim. (1775) 73.

Mugil seheli CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 113; KLUNZINGER, Abh. zool.-bot. Ges. Wien 30 (1870) 827; Fische d. Rothen Meeres 1 (1884) 132; DAY, Fishes of India 4°. (1878–1888) 355; MAX WEBER, Siboga-Exp. Fische (1913) 140; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 252; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 32; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 131; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 125.

Mugil axillaris CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 97; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 444; BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 280; Soc. Ind. Neerl. Act. 6 No. 2 (1871) 34; ALLEYNE and MACLEAY, Proc. Linn. Soc. N. S. Wales 11 (1876) 341; GÜNTHER, Fische d. Südsee 2 (1876–81) 216; MACLEAY, Proc. Linn. Soc. N. S. Wales 7 (1882) 362; SAUVAGE, Hist. Nat. Poissons de Madagascar (1891) 397; SEALE, Occ. Pap. B. P. Bishop Mus. 1 No. 3 (1900) 66.

Mugil parsia CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 107; BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 166; GÜN-

THER, Fische d. Südsee 2 (1876) 216; SEALE, Occ. Pap. B. P. Bishop Mus. 1 No. 3 (1901) 66.

Mugil borbonicus BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 279.

Mugil bleekeri GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 445; MAX WEBER, Zool. Ergebn. Reise N. O. Indien 2 (1894) 416; DE BEAUFORT, Bijd. Dierk., Amsterdam 19 (1913) 107.

Mugil cylindricus BLEEKER, Nat. Tijdschr. Ned. Ind. 4 (1853) 266.

Agonostomus dorsalis STREETS, Bull. U. S. Nat. Mus. 7 (1878) 102.

Mugil decem-radiatus GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 452.

Mugil cæruleomaculatus DAY, Fishes of British India 2 (1889) 351.

Liza cæruleomaculatus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 217.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 40; scales in transverse series 14; head 4; depth 3.7; snout 5.4 in head; eye 4.8; maxillary 4.4; interorbital 1.9; 21 predorsal scales.

Rostro-dorsal profile convex, ventral also convex, making the body appear spindle-shaped. Caudal peduncle compressed, the body becoming gradually wider anteriorly. Body widest at region just behind head, at region of pectorals. Head convex dorsally with width 1.3 in its length. Interorbital convex. Snout slightly convex, its length 2.4 in its width. Eyes greater than snout, 2.4 in interorbital. Adipose eyelid wanting or very poorly developed. Upperlip not particularly thick, fleshy, smooth. Mandibular rami coming together at an obtuse angle. Maxillary completely hidden. Preorbital almost straight and indistinctly denticulate below.

Spinous dorsal origin midway between caudal base and tip of snout, opposite 13th lateral scale. Soft dorsal almost at same level as anal and opposite 26th lateral scale. Caudal peduncle greatly tapering posteriorly, its least depth 1.3 in its length and 2.1 in head. Caudal emarginate. Pectorals weakly falcate, slightly shorter than head and reaching to 12th lateral scale, not quite to level of spinous dorsal origin. Very long and pointed axillary scales present at base of first dorsal, pectorals, and ventrals.

The above description is based on No. 5460 obtained from Sitanki, Sulu, on June 30, 1930. Total length 14 inches.

This species differ from *M. cæruleomaculatus* Lacépède, to which it is closest, in having a greater scale count and in having shorter pectoral fins.

LUZON, Ilocos Sur Province, Nos. 10215, 28410, 6.5 and 4.75 in. long, February, 1923. PALAWAN, Palawan Province, Palawan, Panacan, Nos. 5309, 28336, 4.5 in. long, August 14, 1908. SIQUIJOR, Oriental Negros Province, San Juan, Siquijor, No.

13900, 3.75 in. long, March 10, 1926. MINDANAO, Davao Province, Davao Gulf, No. 3542, 11 in. long, April 10, 1928: Zamboanga Province, Zamboanga, No. 2942, 3.5 in. long, April 10, 1908. TUBINGAN, Sulu Province, No. 13785, 3.5 in. long, March, 1926.

MUGIL AMARULUS Cuvier and Valenciennes.

Mugil amarulus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 133; DAY, Fishes of India, Text Supplement (1878) 356.

Liza amarula JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 11; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 240.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 36; scales in transverse series 12; head 4.25 in standard length; depth 4.25; eye without adipose eyelid, 4 in the head; maxillary visible; preorbital strongly bent, serrate behind; upper lip moderately thick.

Origin of spinous dorsal midway between front edge of eye and caudal base opposite the 11th lateral scale. Dorsal spines weak, the first equalling postorbital part of head. Second dorsal origin slightly behind that of anal and opposite 24th lateral scale. Pectorals about equal to head without the snout. Caudal emarginate, its central rays equal postorbital part of head. Axillary scale on pectoral short, pointed. Second dorsal and anal heavily scaled.

The above description is based on that of Day (1878).

This differs from all other species of *Mugil* with thick upper lip and without adipose eyelid, in having an upper lip without any papillæ and in having weak dorsal spines. Jordan and Seale (1906) reported one specimen 3.25 inches long from Cavite, while Seale and Bean (1907) reported numerous specimens 1 to 4.5 inches long from Zamboanga. This species, however, is not represented in the collection.

MUGIL CRENILABRIS Forskål. Plate 1, fig. 4.

Mugil crenilabris FORSKÅL, Descript. Anim. (1775) 73; CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 91; RÜPPELL, Neue Wirbelthiere, Fische (1836–1840) 132; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 458; KLUNZINGER, Fische d. Rothen Meeres 1 (1884) 132; DE BEAUFORT, Bijdr. tot de Dierk. Afl. 19, Amsterdam (1913) 108; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 256; FOWLER and BEAN, Proc. U. S. Nat. Mus. 71 (1927) 14; FOWLER, Bull. B. P. Bishop Mus. 38 (1927) 1; WHITLEY, Rec. Austr. Mus. 16 (1927) 11; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 126.

Mugil crenilabris KNER, Fische Novara-Exp. (1865–1867) 228; KLUNZINGER, Abh. zool.-bot. Gessellsch., Wien 20 (1870) 826; GÜNTHER, Fische d. Südsee 2 (1876–81) 219; STREETS, Bull. U. S. Nat. Mus. 7 (1877) 93; DAY, Fishes of India 4°. (1878–1888) 355, 800; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Mugil cirrhostomus (Forst.) SCHNEIDER, Bloch Syst. Ichth. (1801) 121; CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 94; LICHTENSTEIN, Forster Descr. Anim. curante (1844) 198.

Mugil fasciatus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 92.

Mugil rüppelli GÜNTHER, Cat. Brit. Mus. 3 (1865–1867) 458.

Mugil neocalidonicus CASTELNAU, Proc. Zool. and Acc. Soc. Victoria 2 (1873) 116.

Mugil papillosus MACLEAY, Proc. Linn. Soc. N. S. Wales 8 (1883) 270.

Liza crenilabris KENDALL and GOLDSBOROUGH, Mem. Mus. Com. Zool. Harvard 26 (1911) 258.

Querimana crenilabris JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 218.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 38–39; scales in transverse series 12; head 4 in standard length; depth 3.6; snout much shorter than eye, 6 in head; eye 3.2 in head; maxillary visible only at tip, 4 in head; interorbital 2; 19–20 predorsal scales.

Rostro-dorsal profile almost straight, from origin of first dorsal to snout tip, very slightly declivous. Greatest depth of body at level of second dorsal and anal origin. Caudal peduncle much compressed, its least depth 1.3 in its length and twice in head. Head width 1.3 in the length, widest at region of opercles. Snout obtuse, almost blunt, its length almost 3 in its width. Eye large, greater than snout, its center at anterior third of head; 1.7 in interorbital. Adipose eyelid poorly developed, almost wanting. Upper lip thick, almost quadrate, forming front border of snout. Its outer surface on the lower third provided with several rows of papillæ which become longer and more prominent ventrally. Lower lip thin, but divided into nine or ten fringes on each side. Mandibular rami coming together at an obtuse angle. Symphysial knob double. No teeth and no cilia. Nostrils far apart, the anterior the smaller, as near to lip border as the posterior is to edge of orbit. Maxillary hidden, except extreme ventral tip which extends to almost level of front border of orbit. Preorbital slightly notched, only denticulate on its lower tip.

Spinous dorsal origin between caudal base and front edge of eye, opposite 13th lateral scale. First dorsal spine equals postorbital part of head. Origin of second dorsal slightly behind that of anal and opposite 24th lateral scale. Caudal emarginate, its lobe pointed. Pectoral more or less falcate, as long as or a little shorter than head, extending posteriorly up to 12th or

13th lateral scale, reaching almost to level of first dorsal origin. Second dorsal, caudal, and anal scaly for the greatest part. Long pointed axillary scales present at base of first dorsal, pectorals, and ventrals.

Represented by a single specimen No. 28472, collected from Lumbucan, Balabac Island, near Palawan, November 29, 1927. Total length 4.75 inches.

This is the first Philippine locality record of this species.

This species differs from *M. labiosus* and *M. joloensis* to which it is closest, in having four series of papillæ on the upper lip and in having the lower lip fringed.

MUGIL JOLOENSIS Seale.

M. joloensis SEALE, Philip. Journ. Sci. § A 4 (1909) 500.

According to Seale, this species has: dorsal IV–I, 7; anal I, 9; scales in longitudinal series 33; scales in transverse series 10; head 4.30; depth 3.60; snout 4.10; eye 3.30; maxillary exposed at tip; interorbital 1.95; pectorals equal to head; ventrals 1.30; least depth of caudal peduncle 2.

Seale's description follows:

> The preorbital has a very deep notch, its depth being greater than width of pupil. The upper lip is very thick, with a fold, fringed with a row of papillæ, an additional row of papillæ on the lip just above the fold an additional fringed fold at each corner of the mouth; under lip with moderately broad membrane. Teeth on tongue, vomer, and palatine, none in jaws. Eye with but the slightest indication of adipose eyelid which is present as a narrow rim to orbit.

This species is not represented in the collection.

MUGIL BANKSI Seale. Plate 1, fig. 11; Plate 2, fig. 2.

Mugil banksi SEALE, Philip. Journ. Sci. § A 4 (1906) 501, pl. 5.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 35–37; scales in transverse series 11; head 4 in standard length; depth 3.4; snout equals eye, 4.2 to 4.5 in head; eye 4 in head; maxillary concealed, 5 in head; interorbital convex, 2 in head; 20 predorsal scales.

Rostro-dorsal profile almost straight, ventral profile very convex, greatest depth of body at level of first dorsal. Caudal peduncle compressed, 1.2 in its length, and equal to postorbital part of head. Head width about 1.5 in its length. Snout obtuse, slightly pointed when viewed from below, its length 2 in the width. Eyes slightly greater than or equal to snout, 1.6 in interorbital. Adipose eyelid poorly developed, almost wanting.

Mouth slightly inferior. Upper lip high, very thick, forming front border of snout. At its lower central border are two or three series of flattened papillæ. Toward the lateral sides of the upper lip these papillæ become transformed into fleshy ridges or lamellæ. Lower lip also somewhat thick, but without fringes. Mandibular rami coming together at an obtuse angle. Symphysial knob prominent. Nostrils far apart, the posterior the larger, the anterior nearer edge of snout than posterior is to edge of orbit. Maxillary hidden except the extreme lower tip which may be visible in young specimens. Preorbital slightly concave, its lower edge truncate with distinct dentition.

Spinous dorsal origin midway between caudal base and front edge of eye, at level of 12th lateral scale. Spines weak, the first 1.8 in the head. Axillary scale at base of first dorsal about $\frac{2}{3}$ of dorsal spine. Second dorsal origin very slightly behind that of anal and opposite 23d lateral scale. Caudal emarginate. Pectorals pointed, almost as long as head, its tip reaching as far back as 12th lateral scale. Axillary scale at its base about 2.6 in its length. Axillary scale present at base of ventral, $\frac{1}{2}$ of the length of first soft rays.

This species differs from *M. labiosus*, as described by Weber and de Beaufort (1922) and Fowler (1928), in having three or four series of papillæ at lower center of upper lip and oblique fleshy folds or lamellæ at the sides. The statement that *M. labiosus* has no fringes or upper lip [Günther (1861) and cited by Seale (1908, p. 501)] is erroneous. It differs from *M. joloensis* Seale in not having a deep notch on the preorbital, in having a greater scale count, and in having no teeth on vomer and palatines.

Seale's type: No. 1412, obtained from Siquijor Island, September 6, 1907.

LUZON, Ilocos Sur, No. 9114, 11.5 in. long, no date. MINDANAO, Misamis Province, Cagayan, Pinacanawan River, No. 10987, 4 in. long, May 17, 1923; Abulog, No. 12838, 9.5 in. long, December 4, 1925; Lanao Province, Kolambugan, Titonod River, Nos. 15083, 15094, 3.5 and 6 in. long, March 7, 1927.

MUGIL LABIOSUS Cuvier and Valenciennes.

Mugil labiosus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 95; BLEEKER, Nat. Tijdschr. Ned. Ind. 6 (1854) 213; Nat. Tijdschr. Ned. Ind. (1858–59) 278; Act. Soc. Sc. Indo-Neerl. 8 (1860) 6; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 454; KLUNZINGER, Abh. zool.-bot. Gesellsch. Wien 20 (1870) 830; Fische d. Rothen Meeres 1 (1884) 133; DAY, Fishes of India 4°. (1878–1888) 357;

MAX WEBER, Siboga-Exp. Fische (1913) 140; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 259; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 126; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Liza labiosa FOWLER, Copeia No. 58 (June, 1918) 62.

Dorsal IV–I, 7–8; anal III, 9; scales in longitudinal series 34–36; scales in transverse series 11–12; head 4 to 4.5 in standard length; depth greater than head; eye 3 to 3.5 in head, without adipose eyelid, maxillary exposed in young individuals, becoming hidden in old specimens; interorbital nearly flat and almost 2 in the head; preorbital bent, emarginate, its end truncate and finely denticulate. Upper lip thick, high. At its lower margin is a shallow groove provided with one row of pointed papillæ.

Rostro-dorsal profile convex or rather steep. Origin of spinous dorsal about midway between snout tip and caudal base, opposite the 11th or 12th lateral scale. Origin of second dorsal at same level as middle of anal and opposite the 23d or 24th lateral scale. Pectorals as long as or slightly longer than head, reaching up or almost to level of first dorsal origin. Caudal emarginate. Axillary scales short.

The above description is based on that of Weber and de Beaufort (1922).

This species differs from *M. banksi* in having only one row of papillæ on the upper lip. Fowler (1918) reported this species as *Liza labiosa* from the Philippines, but none of its examples are present in this Mugilidæ collection.

Genus CESTRÆUS Cuvier and Valenciennes

Mouth cleft usually oblique; upper lip thick fleshy; mandible included; lower jaw with rounded anterior edge and with a cushion-like pad; teeth present on intermaxillary.

CESTRÆUS OXYRHYNCHUS Cuvier and Valenciennes. Plate 1, fig. 13.

Cestræus oxyrhynchus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 162; BLEEKER, Nat. Tijdschr. Ned. Ind. 9 (1855) 307; Act. Soc. Sc. Indo-Neerl. 7 (1860) Negende Bijdr. Vischfauna Sumatra p. 9; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 263.

Agonostoma oxyrhynchum GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 461.

Agonostoma oxyrhynchus BLEEKER, Ned. Tijdschr. Dierk (1865) 191, 291.

Dorsal IV–I, 8; anal III, 9; ventral I, 5; scales in longitudinal series 45; scales in transverse series 14; head 4.2 in the standard length; depth 3.8; snout greater than eye, 3 in head; eye 3.8 in

head, 2 in interorbital; adipose eyelid poorly developed, maxillary exposed, 3.8 in head; interorbital 3.1; 23 predorsal scales.

Rostro-dorsal profile convex; head, interorbital, and snout decidedly convex. Ventral profile also convex, greatest depth at level of first dorsal. Head width 1.5 in its length. Snout pointed, the intermaxillaries covered by a thick fleshy lip. Mouth opening more or less oblique. Mandible included, lower lip with a rounded front edge, thick and fleshy. Intermaxillary teeth in two irregular series anteriorly and three posteriorly; a patch of teeth present on either side of the vomer. Preorbitals scaly, straight and truncate behind; cheek and opercles covered by large prominent scales.

Origin of first dorsal much nearer snout tip than caudal base, opposite 13th or 14th lateral scale. Origin of second dorsal slightly behind that of anal and opposite 27th lateral scale. Both second dorsal and anal slightly emarginate. Depth of caudal peduncle 1.5 in its length and almost twice in head. Pectorals somewhat falcate, slightly shorter than head, reaching as far back as the 13th lateral scale, almost to first dorsal origin. Caudal deeply emarginate.

This species is similar to *Cestræus goldiei* in having two patches of teeth on the vomers, but differs from it in having the second dorsal and anal set far back, opposite the 27th and 25th lateral scales, respectively. Besides this species, *Cestræus goldiei* (Macleay) was reported by Jordan and Richardson (as *Æschrichthys goldiei*) from Mindoro in 1907, and *Cestræus proboscideus* Günther by Borodin (as *Chænomugil proboscideus*) from Sindañgan in 1930.

The above description is based on No. 11368, with a total length of 11.5 inches, obtained from Ilocos Sur Province, Luzon.

Genus MYXUS Günther

Mouth cleft not horizontal, but oblique, usually longer than broad, not reaching to below level of orbit; upper lip thin, not fleshy, usually small; lower jaw thin with angular front edge; a single series of teeth present on intermaxillary, sometimes also on the lower lip.

MYXUS PHILIPPINUS sp. nov. Plate 1, fig. 9; Plate 2, fig. 1.

Dorsal IV–I, 7; anal III, 9; pectorals II, 15; ventral I, 5; scales in longitudinal series 34–36; scales in transverse series

10–11; head 4 in the standard length; depth 3.3; snout 2 in eye, 5 in head; eye 2.5 in head; maxillary visible, 3 in head; interorbital 1.7; 20 predorsal scales.

Rostro-dorsal profile almost straight, from first dorsal origin to snout slightly declivous; ventral side convex in outline. Greatest depth of body at level of first dorsal origin. Caudal peduncle compressed, its least depth slightly less than its length and 1.7 in head. Head width 1.3 in the length, widest at region of opercles. Snout blunt, flat on top, its length 2 in its width. Eye very large, impinging on dorsal profile, twice that of snout, 1.4 in the interorbital. Adipose eyelid wanting. Interorbital flat. Upper lip relatively thick, pigmented, and with a distinct fold on its lower edge. Intermaxillary provided with densely set, prominent teeth. A few teeth also present on mandible. Lower lip thin, smooth, with a notch at middle. Lower jaw more or less angular in profile. Mandibular rami coming together at an obtuse angle. Maxillary exposed at middle and below. Preorbital with a deep, wide notch through which the maxillary is visible. Width of the preorbital notch equal to diameter of pupil.

Origin of spinous dorsal opposite 13th lateral scale, midway between caudal base and center of eye. First dorsal spine greater than the second and 1.4 in the head. Origin of second dorsal opposite middle of anal, and opposite 23d lateral scale. Caudal deeply emarginate. Second dorsal, caudal, and anal scaly at basal half. Pectorals more or less triangular, as long as or longer than head, reaching to 12th or 13th lateral scale, almost to level of first dorsal origin. A long axillary present at base of first dorsal and ventral, but none at pectorals.

Type: No. 28473, 3 inches long, collected from Lumbucan Island, near Balabac, Palawan Province, November 29, 1927. Another specimen, No. 28469 collected from the same place and on the same date is also in the collection.

This is the first species of *Myxus* reported from the Philippines. Günther (1861) as well as Weber and de Beaufort (1922) recorded only one species of this genus from the Indo-Australian region, namely, *M. elongatus*. Mohr (1927) described nine new species of *Myxus* and registered seven old species. The present species resembles *Myxus goniocephalus* Mohr in having the profile of the lower jaw more or less angular, but it is distinct from all other hitherto described forms in having the prominent, wide and deep notch on the preorbital.

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ILLUSTRATIONS

PLATE 1. SCALES OF PHILIPPINE MULLETS

FIG. 1. *Mugil engeli.*
2. *Mugil dussumieri.*
3. *Mugil longimanus.*
4. *Mugil crenilabris.*
5. *Mugil cephalus.*
6. *Mugil macrolepis.*
7. *Mugil melinopterus.*
8. *Mugil cæruleomaculatus.*
9. *Myxus philippinus.*
10. *Mugil seheli.*
11. *Mugil banksi.*
12. *Mugil vaigiensis.*
13. *Cestræus oxyrhynchus.*

PLATE 2

FIG. 1. *Myxus philippinus,* character sketch.
2. *Mugil banksi,* ventral view of head.
3. *Mugil ceramensis,* scale.
4. *Mugil ceramensis,* ventral view of head.

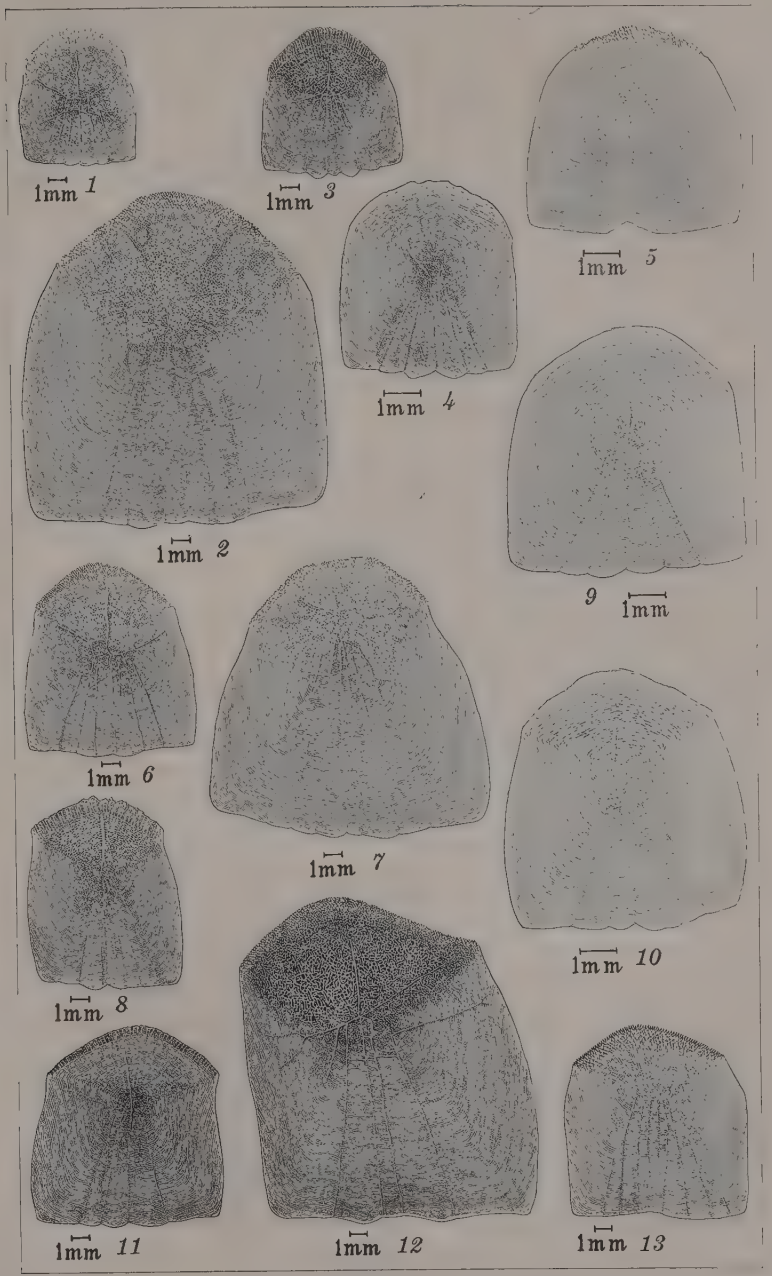
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PLATE 1.

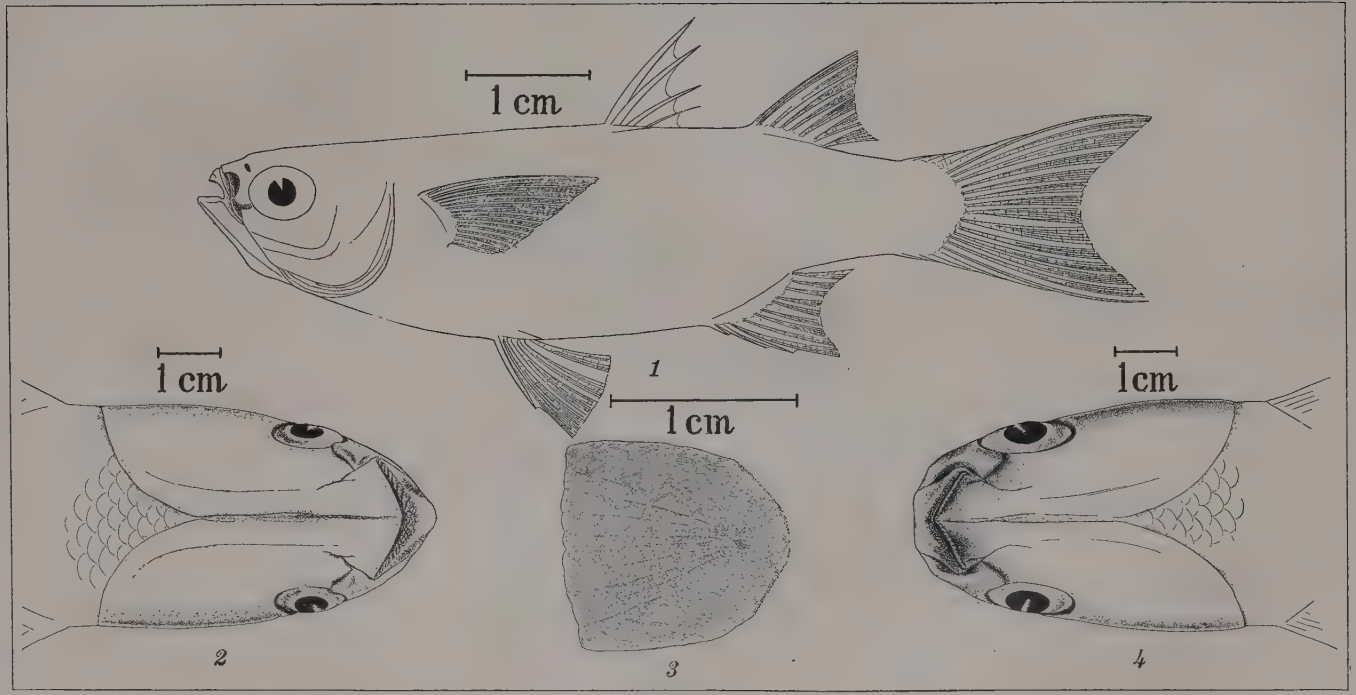

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XX[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

TWO PLATES

The majority of the species of crane flies discussed herewith are from western Java where they were taken by Mrs. M. E. Walsh and Mr. Owen Bryant; this material is preserved in my collection, the Bryant material through the friendly interest and generosity of the late Mr. Charles W. Johnson. Other species considered are from northern Celebes, collected by Mr. Charles F. Clagg, and from New Caledonia, taken by Dr. Jean Risbec, this material likewise being in my possession through the kindness of the collectors. A further important series of species are from northeastern New Guinea, where they were secured by the late Ludwig Biró, former Custos of the Hungarian National Museum, and loaned me for study by Dr. Z. Szilady; the types of this material are preserved in the Hungarian National Museum. Much of this last-mentioned material had earlier been reviewed by Riedel,[2] but in several instances, due to the incomplete knowledge of the Tipulidæ of Australasia and Wallacea at that date, many of the species had been left incompletely determined by Riedel and are further discussed at this time.

TIPULINÆ

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

This superb fly was described from a unique female taken on the Goenoeng Susuruh, Preanger, western Java, by Corporaal. A small series is now available, including the hitherto unknown male, which is herewith defined as allotype.

[1] Contribution from the entomological laboratory, Massachusetts State College.

[2] Ann. Mus. Nat. Hungarici 18 (1921) 129–144.

Allotype, male, Djampangs, western Java, altitude 1,500 to 2,000 feet, April 27, 1933 (*Walsh*).

Male.—Length, about 16 millimeters; wing, 17.

Characters almost exactly as in female, except in the usual sexual differences. Head more orange than brownish red. Maxillary palpi with basal three segments obscure yellow, the terminal segment abruptly blackened. Wings intensely black. Abdomen black, with pale yellow on middle of tergites three to five and extreme caudal margin of two.

Other specimens: Males and females, Djampangs, 1,500 to 2,000 feet, February to May, 1933 (*Walsh*); one female, Wynkoops Bay, western Java, April, 1933 (*Walsh*).

PSELLIOPHORA TINCTIPENNIS ORBITALIS subsp. nov.

Male.—Length, about 12.5 millimeters; wing, 12.

Female.—Length, about 15 to 17 millimeters; wing, 13 to 15.5.

Agreeing closely with typical *tinctipennis* Edwards, of Burma and the Malay Peninsula,[3] differing in the following regards:

Female.—Head black, conspicuously pruinose; frontal prolongation of head light ashy gray; orbits and occiput conspicuously more ocherous. Halteres entirely black. Wings with cell M_1 short-petiolate; fringe of setæ on petiole long and relatively abundant. Abdomen with basal four tergites and extreme cephalic end of fifth orange; succeeding tergites, including genital shield and all valves, deep black; basal five sternites orange, with a further slight encroachment onto the sixth segment.

Male.—Similar. Antennæ entirely black, including all branches. Præscutum with three more-saturated stripes that are but little evident against the ground. Abdomen orange; segments five to eight black, excepting the extreme bases of both the tergite and sternite of segment five; segment nine chiefly obscure reddish orange, the outer ends and appendages blackened.

Habitat.—Western Java.

Holotype, male, Djampangs, altitude 1,500 to 2,000 feet, May, 1933 (*Walsh*). Allotopotype, female. Paratypes, 1 female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*Walsh*); 2 females, Selabintanah, Mount Gedeh, altitude 3,000 feet, March, 1933 (*Walsh*).

I believe that when the males of the two forms are available for direct comparison the present fly will require specific ranking.

[3] Bull. Raffles Mus. 7 (1932) 65–66.

Genus DOLICHOPEZA Curtis

Subgenus EUNESOPEZA subgen. nov.

Characters as in *Nesopeza* Alexander, differing in the presence of only three outer branches of media, interpreted as being M_{1+2} M_3, and M_4, with veins M_1 and M_2 fused to the margin.

Type of subgenus.—*Dolichopeza* (*Nesopeza*) *defecta* Edwards (Oriental: North Borneo).

Dolichopeza (*Nesopeza*) *epiphragmoides* Edwards (North Borneo) likewise belongs here. My good friend Edwards,[4] in describing the above very distinct species of *Dolichopeza,* did not consider the venational feature described above as being of primary importance. However, the presence of only three outer branches of media is so uncommon in the entire subfamily Tipulinæ (*Idiotipula* Alexander, Ethiopian; *Xenotipula* Alexander, Ethiopian; *Leptotarsus* Guerin: *Pseudoleptotarsus* Alexander, Australian; *Tipula* Linnæus: *Nesotipula* Alexander, Nearctic) that I believe the present group should rank as a subgenus.

DOLICHOPEZA (NESOPEZA) NEBULICOLA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Nesopeza gracilis de Meijere (in part); ALEXANDER, Proc. U. S. Nat. Mus. 49 (1915) 179.

Allied to *gracilis;* mesonotal præscutum reddish brown without clearly defined stripes; dorsal pleurites darkened, the ventral pleurites and all coxæ light yellow; wing veins brown; male hypopygium with the outer dististyle narrow, the apex a glabrous point; eighth sternite with the caudal margin almost evenly rounded, without lobes, the border on either side of the midline with two large setiferous punctures.

Male.—Length, about 10 millimeters; wing, 10.5.

Rostrum dark brown; palpi black. Antennæ with basal three segments light yellow; remainder broken. Head dark brown, the anterior vertex more pruinose; anterior vertex approximately twice as wide as diameter of scape.

Mesonotal præscutum reddish brown, without clearly defined stripes; scutal lobes testaceous brown, the centers of lobes more reddish brown; posterior sclerites of notum reddish brown. Pleura with dorsal sclerites, including the anepisternum, dorsal pteropleurite and pleurotergite dark brown; ventral pleurites

[4] Journ. Fed. Malay St. Mus. 17 (1933) 289.

and all coxæ pale yellow. Halteres pale yellow, knobs brownish black. Legs with coxæ as described; trochanters yellow; remainder of legs broken. Wings (Plate 1, fig. 1) with the brown pattern of *gracilis* and allies; central portion of cell Sc_2 brightened; veins brown, including the medial veins. Macrotrichia of veins relatively abundant, including a series on distal third of vein 1st A. Venation: Spur at origin of Rs long and gently curved; medial forks deep; m-cu more than one-half its length before the fork of M.

Abdomen with basal segments more or less bicolorous, yellow and brown, the outer segments more uniformly darkened; hypopygium dark. Male hypopygium with the ninth tergite having only a low, obtuse, median lobule. Outer dististyle (Plate 2, fig. 25, *od*) unusually slender, especially in lateral view, as shown, the tip narrowed into a glabrous point. Eighth sternite, 8*s*, with caudal margin evenly rounded or with the median portion narrowly truncate, the mid-area at margin pale and membranous, continued caudad the entire length of sclerite as a weak impressed line; at caudal border, on either side of midline, with two short points on either side, these apparently representing basal spurs of powerful setæ.

Habitat.—Western Java.

Holotype, male, Tjibodas, Mount Gedeh, altitude 9,000 feet, 1909 (*Bryant and Palmer*). Paratopotype, male, in United States National Museum, determined by myself as *gracilis*, 1914.

It is evident that there are numerous Malayan species of *Nesopeza* that are closely allied to *gracilis* but differ in a decisive manner in the structure of the male hypopygium. The present fly and the species next to be described had earlier been misdetermined by me as being *gracilis*. Edwards [5] has described the hypopygium of *gracilis* which has thus been shown to be a very distinct fly, with a greatly modified eighth sternite. I have male specimens of this same species from Sumatra and Java and it is evident that Edwards's conception of *gracilis* is the correct one.

DOLICHOPEZA (NESOPEZA) INSOLIDA sp. nov. Plate 2, fig. 26.

Nesopeza gracilis de Meijere (in part); ALEXANDER, Proc. U. S. Nat. Mus. 49 (1915) 179.

Allied to *gracilis;* mesonotum light reddish brown to testaceous brown, unmarked; dorsal pleurites darkened, the ventral pleu-

[5] Bull. Raffles Mus. 7 (1932) 53.

rites and all coxæ clear light yellow; wings whitish subhyaline with a dark costal pattern; veins of undarkened portions light yellow; anterior cord nearly transverse; abdominal tergites darkened, with an obscure yellow area on sides at near midlength of the segments; male hypopygium with median lobe of tergite very low and obtuse; outer dististyle long and narrow, with setæ to apex; inner dististyle with a deep U-shaped incision on side; eighth sternite broadly transverse, the caudal margin very gently rounded, without setæ except on sides.

Male.—Length, about 9 millimeters; wing, 9.

Frontal prolongation of head dark brown; palpi brown. Antennæ with basal two segments yellow, flagellum brown; flagellar segments long-cylindrical, with dense short pubescence and short verticils. Head light brown; anterior vertex relatively narrow.

Mesonotum entirely uniform light reddish brown to testaceous-brown, unmarked. Pleura with the dorsal sclerites darkened, extending from the propleura to base of abdomen, the ventral pleurites abruptly light yellow. Halteres yellow, the knobs blackened. Legs with the coxæ and trochanters pale yellow; femora whitish yellow, the tips blackened; tibiæ white, the tips narrowly blackened; tarsi white. Wings with the ground color whitish subhyaline, the dark costal pattern about as in *gracilis;* a whitish spot in basal costal cell, before h; dark seam on anterior cord narrow and nearly transverse in position; no darkening on posterior cord or on posterior margin at termination of vein Cu; veins of undarkened portions of wing light yellow, much paler than in *nebulicola.* Venation: Spur at origin of Rs straight; anterior cord nearly transverse; medial forks shallower than in *nebulicola;* cell 2d A a little narrower.

Abdominal tergites chiefly darkened, the segments variegated with obscure yellow on sides at near midlength of the segments; outer segments more uniformly darkened. Male hypopygium with the median lobe of tergite very low and obtuse. Outer dististyle (Plate 2, fig. 26, *od*) relatively long and narrow, with conspicuous setæ to apex. Inner dististyle, *id,* with a deep U-shaped incision, cutting off a slender basal lobe from the outer beaklike portion. Eighth sternite, 8*s,* broadly transverse, the caudal margin very gently rounded, entire; median area without setæ, these punctures occurring on subbasal half of sclerite and on sides of the rounded portion.

Habitat.—Western Java.

Holotype, male, Tjibodas, Mount Gedeh, altitude 4,500 feet, 1909 (*Bryant and Palmer*). Paratopotype, male, in United States National Museum, determined by myself as *gracilis*, 1914.

The distinctions between this species and the other regional members of the group are indicated in the above diagnosis and in the account given under the description of *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov.

DOLICHOPEZA (NESOPEZA) SUBCUNEATA sp. nov. Plate 1, fig. 2; Plate 2, figs. 27, 28.

Belongs to the *cuneata* group; most nearly allied to *cuneata*, differing chiefly in the details of the male hypopygium; ninth tergite with median lobe short, the lateral shoulders obtuse; outer dististyle short and dusky; eighth sternite large and conspicuously sheathing, its caudal margin obtusely rounded.

Male.—Length, about 10 millimeters; wing, 10.5.

Female.—Length, about 11.5 millimeters; wing, 10.8.

Frontal prolongation of head obscure yellow; basal two segments of palpi yellow, terminal segments blackened. Antennæ with pedicel light yellow, the remainder of organ black; flagellar segments (male) with very short verticils. Head with anterior vertex brownish yellow, the posterior portions darker brown.

Mesonotal præscutum with four dark reddish brown stripes that are a trifle paler than the interspaces; posterior sclerites of notum uniformly darkened. Pleura yellow, variegated with brown, the latter color on the anepisternum, dorsal pteropleurite, dorsal pleurotergite, ventral sternopleurite, and ventral meral region. Halteres elongate, pale yellow, the knobs blackened. Legs with coxæ and trochanters pale yellow; femora brown, obscure yellow basally, the tips passing into black; tibiæ brownish black, the tips passing into black, the extreme bases whitened; basitarsi extensively blackened, the fore pair white at both ends, the bases about one-half as extensively as the tips; mid-pair with only the tips narrowly whitened; posterior pair with the black ring narrow, the bases and tips broadly and subequally whitened; remainder of tarsi white, the last segment a little darkened. Wings (Plate 1, fig. 2) with a dusky tinge, cell Sc more darkened; stigma oval, dark brown; veins black. Venation: Rs subequal to or shorter than R_{2+3}; m-cu only a short distance before fork of M; Cu_2 reaching wing margin; vein 2d A running very close to the anal margin, as in group.

Abdominal segments bicolorous, the incisures brownish black, the bases more narrowly darkened; intermediate portions of segments narrowly obscure yellow; sternites more extensively pale.

Male hypopygium with the median lobe of tergite (Plate 2, fig. 27, 9*t*) shorter than in *cuneata* (Plate 2, fig. 28, 9*t*), the lateral shoulders obtuse, acute in *cuneata*. Outer dististyle, *od*, short and dusky, in length considerably shorter than the inner dististyle, *id*. Eighth sternite conspicuously sheathing, much larger than in *cuneata*, its apex obtusely rounded, provided with setæ of moderate length; in *cuneata*, the margin transverse or subtransverse, with long powerful setæ.

Habitat.—Western Java.

Holotype, male, Bibidjilan, Djampangs, altitude 2,000 feet, September, 1933 (*M. E. Walsh*). Allotopotype, female.

Although closely allied to *Dolichopeza* (*Nesopeza*) *cuneata* Edwards (North Borneo, in mountains), I must regard the present fly as being distinct. It is more remotely allied to *D.* (*N.*) *angusta* Edwards (Malay Peninsula) and *D.* (*N.*) *sandakanensis* Edwards (Borneo, lowlands), which again differ chiefly in the structure of the male hypopygia.

SCAMBONEURA MINAHASA sp. nov. Plate 1, fig. 3.

Thoracic dorsum reddish yellow, without markings; antennal flagellum bicolorous; legs yellow throughout, the outer tarsal segments darkened; wings light yellow, cell Sc clearer yellow; anterior cord subtransverse, only slightly bowed; abdominal tergites yellow, each with a quadrate blackish area on disk, these broadly interrupted at the incisures.

Female.—Length, about 16 to 17 millimeters; wing, 12.5 to 13.5.

Frontal prolongation of head, including nasus, yellow; palpi yellow, only the terminal segment darkened. Antennæ with scape, pedicel, and first flagellar segment yellow; succeeding flagellar segments bicolorous, the bases brownish black, the apices obscure yellow, on outer segments uniformly darkened. Head obscure yellow, the occipital brand lacking or scarcely differentiated from the color of the remainder of head.

Mesonotum uniform reddish yellow, without markings, the surface subnitidous. Pleura yellowish testaceous, unmarked. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters yellow, remainder of legs yellow, the outer tarsal segments passing into brownish black. Wings (Plate 1, fig. 3) with the ground color light yellow, cell Sc clear yellow; stigma brown; veins brown, prearcular veins and Sc more yellowish. Macrotrichia of veins of moderate length only. Venation: Anterior cord only slightly bowed, subtransverse, the inner end of

cell R_5 a very little more proximad than that of cell R_3; a strong arcuation on r-m near its cephalic portion; Rs lying distinctly distad of r-m.

Abdominal tergites yellow, each with a quadrate blackish area on disk, broadly interrupted on the incisures, more broadly so on the bases of the segments than on the apices; sternites pale but almost hidden by the tergites, the exposed outer two sternites more darkened.

Habitat.—Northern Celebes.

Holotype, female, Roeroekan, Minahassa, altitude 4,000 feet, April 18, 1931 (*Clagg*). Paratopotype, female, April 13, 1931.

The species is named after an aboriginal tribe of northern Celebes, the Minahasa. In the venation, especially the subtransverse anterior cord, the present fly is closest to the otherwise very different *Scamboneura subtransversa* Alexander (Luzon). In the immaculate mesonotum, it agrees more nearly with *S. claggi* Alexander (Mindanao) and *S. primogenia* Alexander (Luzon), differing in the venation and bicolorous flagellum. The venation of *S. minahasa* is very like that of the species identified by Edwards from north Borneo as *S. quadrata* de Meijere.[6] According to de Meijere's original description of *quadrata*[7] his species (from Java) has a venation agreeing exactly with Osten Sacken's figure of *S. dotata* Osten Sacken[8] that is with the strongly bowed anterior cord of the wing, quite different from the more-generalized condition obtaining in the present fly.

SCAMBONEURA SUBFACETA sp. nov. Plate 1, fig. 4.

Mesonotum yellow, the præscutum with three blackish stripes that are not bordered by darker; scutellum and mediotergite yellowish; antennal flagellum brownish black; wings with a faint brown tinge; stigma unusually small, brown; abdominal tergites yellow, with large brownish black areas on each segment.

Female.—Length, about 17 millimeters; wing, 14.5.

Frontal prolongation of head yellow, more orange-yellow dorsally; nasus long and slender; basal segment of palpi testaceous, the outer segments brown. Antennæ with scape orange-yellow, pedicel yellow; flagellum brownish black, the distal ends of basal three segments very vaguely paler but the organ definitely unicolorous. Head obscure brownish orange, the small occipital brand darker, its limits not well-marked.

[6] Journ. Fed. Malay St. Mus. 16 (1931) 504.
[7] Tijd. voor Ent., Suppl. 56 (1913) 8–9.
[8] Berlin. Ent. Zeitschr. 26 (1882) 95, fig. 1.

Pronotum reddish brown, bordered by yellow. Mesonotum yellow, the præscutum with three blackish stripes that are not bordered by other colors, the median stripe with lateral margins of cephalic portion vaguely pruinose, the remainder of stripes polished; scutal lobes almost entirely covered by a polished black area on each; scutellum brownish yellow, the extreme cephalic end clearer yellow; mediotergite yellow, the posterior border darker. Pleura obscure yellow, vaguely patterned on anepisternum with more reddish. Halteres obscure yellow, the extreme base of stem pale. Legs with the coxæ and trochanters yellow; femora brownish yellow, clearer yellow basally; tibiæ light brown; tarsi passing into brownish black. Wings (Plate 1, fig. 4) with a faint brownish tinge, cell Sc more yellowish; stigma unusually small, brown; veins brownish black. Venation: R_3 elongate, running close to costa, with trichia only on basal third, the distal portion whitish; anterior cord strongly bowed, as usual in the more-specialized forms of the genus, the most basal point being on r-m just before it unites with R_{4+5}; forks of medial cells deep.

Abdominal tergites with a large brownish black area on each segment, narrow on basal portion, thence broadened and occupying the disk of the segment, the caudal and lateral margins broadly yellow; sternites uniformly yellow.

Habitat.—Northern Celebes.

Holotype, female, Roeroekan, Minahassa, altitude 4,000 feet, April 17, 1931 (*Clagg*).

Although very close (at least in the female sex) to *Scamboneura faceta* Alexander (Alabat Island, Luzon) I must regard the present fly as being distinct. The coloration of the posterior sclerites of the mesonotum and the details of venation of the radial field, especially the length and close approximation to the costal margin of vein R_3, furnish the most obvious characters in this sex.

MACROMASTIX RISBECI sp. nov. Plate 1, fig. 5.

Antennæ (male) elongate; with abundant, relatively short, erect setæ; eyes (male) very large, reducing the vertex to a narrow strip; general coloration of thorax light reddish brown, the pleura yellow; wings brownish yellow, the oval stigma dark brown; abundant macrotrichia on outer radial and medial veins; r-m connecting with Rs before its fork; cell M_1 short-petiolate; m-cu at midlength of cell 1st M_2; abdominal tergites conspicuously dimidiate, dark brown, broadly margined caudally with yellow; sternites chiefly light yellow; hypopygium dark brown.

Male.—Length, about 7.5 millimeters; wing, 9.5; antenna, about 11.

Frontal prolongation of head of moderate length, about one-third the remainder of head, light brown, without nasus; palpi dark brown. Antennæ (male) elongate, exceeding the wing in length; second to seventh flagellar segments longer than the first; flagellar segments with an abundant erect pubescence that is much shorter than in the male sex of *cockerellæ*, the longest not exceeding three times the diameter of segment at point of insertion; on first flagellar segment, the setæ are even finer and denser, the longest shorter than the diameter of the segment; scape and pedicel yellow; basal flagellar segments obscure yellow, the apices narrowly darkened, this color becoming more extensive on the fourth segment, the succeeding segments uniformly dark brown. Eyes very large, on dorsum reducing the vertex to a narrow strip; visible portions of head testaceous brown.

Pronotum obscure yellow. Mesonotal præscutum and scutum uniformly light reddish brown, the former somewhat darker in front; scutal lobes with centers slightly darkened; scutellum testaceous brown; mediotergite light brown, pale laterally. Pleura yellow, the pleurotergite light brown. Halteres dark brown, the base of stem narrowly yellow. Legs with the coxæ and trochanters yellow, the mid-coxæ slightly darker; femora obscure yellow, the tips narrowly blackened, the amount subequal on all legs; tibiæ dark brown; tarsi brownish black. Wings (Plate 1, fig. 5) with the ground color brownish yellow, cells C and Sc clearer yellow; stigma oval, dark brown; wing tip and margin as far back as vein Cu_1 insensibly suffused with brown; very narrow and ill-defined darkenings along cord, most evident on anterior cords; veins brown, more yellow in the costal field. An abundant series of macrotrichia on entire length of veins R_3, R_{4+5}, M_1, M_2, M_3, M_4, and distal section of Cu_1; no trichia on R_{1+2} or R_2. Venation: R_{1+2} about in longitudinal alignment with R_2; r-m connecting with Rs immediately before the fork; cell M_1 very deep, its petiole only about one-third m; basal section of M_3 longer than m and not in transverse alignment with it, so m-cu is at midlength of cell 1st M_2; cell 2d A wide.

Abdominal tergites conspicuously bicolorous; segment one obscure yellow; segment two dark brown on basal ring, the apical ring yellow; segments three and four dark brown basally, the apices broadly yellow; segment five uniformly brownish black; segments six and seven almost uniformly yellow; sternites light

yellow, the apices of segments five and six narrowly darkened; hypopygium dark brown.

Habitat.—New Caledonia.

Holotype, male, Poindimie, July 13, 1931 (*J. Risbec*).

I take great pleasure in naming this distinct fly in honor of Prof. Jean Risbec, distinguished malacologist. The interrelationships of the four species of *Macromastix* now known from New Caledonia are shown by the following key.

Key to the species of Macromastix of New Caledonia.

1. Wings veins beyond cord with numerous trichia, including complete series on veins R_3, M_1, M_2, M_3, M_4, and distal section of Cu_1; r-m connecting with Rs before fork; antennæ (male) elongate.
risbeci sp. nov.

   Wing veins beyond cord glabrous or nearly so, at most with an incomplete series on outer portion of vein R_{4+5}; r-m connecting with R_{4+5}, the basal section of the latter conspicuous; antennæ (male) short or elongate ..... 2.

2. Antennæ short in both sexes; m-cu opposite midlength of cell 1st M_2, the basal section of M_3 not being in alignment with m.
novocaledonica Alexander.

   Antennæ (male) elongate, in female shorter but still about as long as the thorax alone; m-cu opposite or beyond the outer end of cell 1st M_2, the basal section of M_3 being in transverse alignment with m or approximately so ..... 3.

3. Abdominal tergites uniformly dark brown; antennæ (male) of moderate length, subequal to wing (12 millimeters or less).
cockerellæ Alexander.

   Abdominal tergites conspicuously ringed caudally with silvery; antennæ (male) very long (20 millimeters), being about a third longer than wing ..... *caledoniana* sp. nov.

MACROMASTIX CALEDONIANA sp. nov. Plate 1, fig. 6.

Antennæ (male) elongate, the flagellar segments with abundant long erect setæ; thorax obscure yellow, the præscutum with four reddish brown stripes; wings pale yellowish subhyaline, the stigma scarcely darker; outer veins of wing without trichia, excepting a series on outer half of R_{4+5}; r-m a little longer than the basal section of R_{4+5}; m-cu opposite outer end of cell 1st M_2; abdominal tergites dark brown, the caudal borders broadly silvery gray.

Male.—Length, about 12 millimeters; wing, 15; antenna, about 20.

Frontal prolongation of head light brown; palpi more testaceous-yellow, the terminal segment darkened. Antennæ (male) elongate, much exceeding the wing length; first flagellar segment relatively short, less than one-half the second; second segment

nearly three-fourths the third; flagellar segments with long erect setæ that are much longer than the diameter of segment at point of insertion; on first segment about four times this diameter, on the outer more slender segments six or seven times this diameter; scape and pedicel brownish yellow; basal flagellar segments brownish yellow, the outer segments more uniformly dark brown. Eyes large; anterior vertex wide, approximately twice the diameter of scape, reddish brown, suffused with darker brown.

Mesonotal præscutum short, obscure yellow, with four reddish brown stripes, intermediate pair confluent in front; anterior interspaces with golden yellow setæ; scutum and scutellum more testaceous-yellow, the scutal lobes slightly and indistinctly darkened; mediotergite yellowish gray. Pleura yellow, the propleura and posterior portion of anepisternum infuscated; a linear blackish area on cephalic border of pteropleurite, ventrad of wing root. Halteres with stem pale yellow, knobs broken. Legs with the coxæ and trochanters yellowish testaceous; femora obscure yellow, the tips narrowly brownish black; tibiæ obscure yellow, the outer ends and the tarsi brownish black. Wings (Plate 1, fig. 6) pale yellowish subhyaline, cell Sc weakly darkened; stigma scarcely darker; veins bright reddish brown. No macrotrichia on vein R_3 or on any medial veins; a series of trichia on distal half of outer section of R_{4+5}. Venation: Free tip of Sc_2 lying very close to R_{1+2} and parallel with it, cell Sc_2 thus very narrow; R_{1+2} in longitudinal alignment with R_2, r-m only a trifle longer than basal section of R_{4+5}; petiole of cell M_1 a little shorter than m; basal section of M_3 in transverse alignment with m, m-cu lying on M_4 beyond the fork and thus opposite or slightly beyond the outer end of cell 1st M_2; cell 2d A wide.

Abdominal tergites beyond the brownish yellow first segment dark brown, the caudal borders broadly silvery gray; seventh tergite chiefly yellow; remaining segments and hypopygium chiefly dark brown; sternites yellow, the outer segments darkened.

Habitat.—New Caledonia.

Holotype, male, Ponerihouen, July 7, 1931 (*J. Risbec*).

The nearest ally of the present fly is *Macromastix cockerellæ* Alexander, as is shown by the key to the species in New Caledonia given with the preceding form.

TIPULA LEUCOSTICTA sp. nov. Plate 1, fig. 7; Plate 2, fig. 29.

Belongs to the *omissinervis* group; antennal flagellum bicolorous; mesonotal præscutum with three reddish brown stripes

that are narrowly bordered by darker brown; tarsi and tips of tibiæ white; wings with a restricted but conspicuous brown pattern, together with several small white to yellowish white spots; m-cu opposite midlength of M_{3+4}; male hypopygium with the outer dististyle terminating behind in an acute spinous point.

Male.—Length, about 15 millimeters; wing, 16.

Frontal prolongation of head light brown; nasus long and slender. Antennæ relatively short, only a little longer than the combined head and front; basal three segments light yellow; succeeding segments bicolorous, black basally, the tips yellow, the outer segments more uniformly darkened; verticils very long and conspicuous, exceeding twice the length of the segments.[9] Head obscure fulvous, the center of vertex darker, sending a narrow brown vitta onto the low vertical tubercle.

Pronotum dark brown above, gray laterally. Mesonotal præscutum with the ground color grayish brown, with three reddish brown stripes that are narrowly bordered by darker, the lateral margin of the median stripe connected across humeri with the pseudosutural fovea by a dusky line, delimiting the interspaces in front; extreme cephalic portion of median stripe with a black streak, indicating the position of a normal median dark vitta; scutellum and mediotergite reddish brown, more grayish laterally. Pleura pale yellow, variegated by pale brown spots. Halteres elongate, dark brown, base of stem light yellow. Legs with coxæ pale yellow, variegated by pale brown spots at tips and bases; trochanters pale yellow; femora light brown, the tips passing into black; tips of tibiæ and the tarsi yellowish white; remainder of tibiæ brownish black (Riedel says with white rings at bases of tibiæ, legs now badly broken). Wings (Plate 1, fig. 7) with a faint brown tinge, stigma and costal region darker brown; arcular region narrowly darkened; a narrow seam along cord, broken at fork of M; outer radial cells to wing tip narrowly darkened; a brown spot at just beyond one-third the length of cell Cu, followed by a clear hyaline spot of equal size; several white or yellowish white spots on wing, as follows: A major area before stigma and anterior cord; a small poststigmal area; small yellow spots at ends of veins R_3 and R_{4+5}; white obliterative points across cell 1st M_2, including basal sections of veins M_{1+2} and M_3; veins very delicate, brown. Veins behind R unusually glabrous, with a single strong seta

[9] As figured by Riedel, as *Tipula venusta;* Ann. Mus. Nat. Hungarici 18 (1921) 142, fig. 7.

on Rs. Venation: R_{1+2} entirely atrophied, as in group; Rs short, pale; cell 1st M_2 large; m-cu at midlength of vein M_{3+4}; petiole of cell M_1 about twice m; Cu_2 extending entirely to margin; cell 2d A of moderate width.

Abdomen darkened. Male hypopygium (Plate 2, fig. 29) with the tergite, 9*t*, separated from the sternite, 9*s*, by membrane; basistyle entirely fused with sternite except for a delicate ventral suture. Ninth tergite, 9*t*, with the caudal margin having a broad V-shaped notch, the lateral lobes thus formed obliquely truncated, with abundant setigerous punctures; dorsal portion of tergite entirely without a median depressed line. Outer dististyle, *od*, with the cephalic lobe flattened, the posterior portion directed caudad and mesad into a powerful spine that terminates in a blackened point and bears another similar black spine on side before tip (*od, va*, ventral aspect). Inner dististyle, *id*, with a blackened detached blade on inner face near base; outer margin of style with long delicate setæ in an almost continuous row, as in most species of *Indotipula*. Eighth sternite, 8*s*, unarmed.

Habitat.—New Guinea.

Holotype, male, Stephansort, Astrolabe Bay, March 30, 1900 (*Biró*).

This specimen had earlier been referred to *Tipula* (*Tipulodina*) *venusta* Walker by Riedel,[10] but certainly does not pertain to that subgenus or species. It is allied to *Tipula omissinervis* de Meijere, *T. dentata* de Meijere, and *T. divergens* de Meijere, all from various parts of New Guinea. The coloration of the legs of the present fly readily separates it from all of the three allies indicated. It seems certain that a new subgeneric group will be required for these species, falling close to *Acutipula* Alexander, *Indotipula* Edwards, and *Tipulodina* Enderlein.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) PACATELLA sp. nov. Plate 1, fig. 8.

Belongs to the *pacata* group; mesonotal præscutum with cephalic and lateral portions broadly obscure brownish yellow, the central portion of disk dark brown; dorsal pleurites largely covered by a broad, brownish black, longitudinal stripe.

Female.—Length, about 4.5 millimeters; wing, 4.5.

[10] Loc. cit.

Rostrum and palpi brownish black. Antennæ black throughout; flagellar segments oval, the terminal segment considerably longer than the penultimate. Head brownish black.

Mesonotal præscutum with cephalic and lateral portions broadly obscure brownish yellow, the restricted central portion of disk dark brown, the latter color thus virtually restricted to the posterior portion of the usual median stripe; scutal lobes dark brown, the median region of scutum narrowly pale; posterior sclerites of notum brown. Pleura obscure brownish yellow dorsally, with a broad, brownish black, longitudinal stripe extending from the cervical region to the abdomen, inclosing the root of halteres; ventral sclerites, including the entire sternopleurite and meral region, abruptly light yellow. Halteres blackish, the extreme base of stem obscure yellow. Legs with fore coxæ weakly darkened basally; remaining coxæ and trochanters yellow; femora and tibiæ brown, the tips still darker; tarsi paling to dirty brownish white. Wings (Plate 1, fig. 8) with a brownish tinge, the oval stigma darker brown; a very vague darkening along cord and vein Cu_1; veins brown. Venation: Sc relatively long, Sc_1 ending about opposite three-fourths the length of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in transverse alignment; Rs weakly angulated at origin, nearly three times the basal section of R_{4+5}; cell 1st M_2 open by atrophy of m; m-cu at fork of M; anal veins strongly convergent at bases.

Abdominal tergites dark brown; sternites light yellow. Ovipositor with cerci very small and slender at tips; hypovalvæ stouter, their bases conspicuously blackened.

Habitat.—Western Java.

Holotype, female, Soekaboemi, altitude 1,800 feet, June 3, 1933 (*M. E. Walsh*).

The nearest described ally is *Limonia* (*Limonia*) *subprolixa* Alexander (Mindanao), which differs in the larger size, more uniform coloration of the mesonotum, the scarcely or but slightly darkened thoracic pleura, and the details of venation, as the longer Rs and more extended cell 2d A. I am not at all certain that *L.* (*L.*) *pacatina* Edwards (North Borneo) belongs to this same group, despite the close resemblance in structure of the male hypopygium. Cell 1st M_2 is closed and the general appearance is rather different from the other members of the *pacata* group.

LIMONIA (LIBNOTES) RIEDELELLA sp. nov. Plate 1, fig. 9.

Libnotes species RIEDEL, Ann. Mus. Nat. Hungarici 18 (1921) 134.

The specimen upon which this description is based was received by me from Doctor Szilady in fragmentary condition, almost the only parts of the body remaining being the wings and legs. Since the chief specific characters in the subgenus lie in these two organs, I do not hesitate to describe this very distinct species as new, using some of the characters earlier mentioned by Riedel in his brief account of the fly as cited above (No. 17).

Male.—Length, about 15 millimeters; wing, 18.

Having the general appearance of *Limonia* (*Libnotes*) *affinis* (de Meijere). General coloration of entire body pale yellow. Legs yellow; femora before tips with a relatively narrow brown ring; tibiæ yellow, the tips narrowly dark brown, with a moderately broad brown subbasal ring, placed about its own length beyond the base and about one-half wider than the subapical ring on femora; tarsi yellow, the tips of segments one and two, and all of segments three and four, brown. (Riedel describes the tibia as having a subterminal dark ring but in the detached legs that I associate with the above fly, the coloration is more as noted.) Wings (Plate 1, fig. 9) yellowish, with a restricted brown pattern, including two larger areas at tip of Sc and tip of R_1, respectively; other smaller dark seams on veins, including the cord, outer end of cell 1st M_2, the supernumerary crossveins in radial field, a spot on R_3 before midlength and on the outer third of M_{1+2}; small marginal clouds on M_3, M_4, Cu_1, and the anal veins; axillary region darkened; veins yellow, darker in the clouded areas. Macrotrichia at base of costa small and relatively sparse. Venation: Free tip of Sc_2 and R_2 in transverse alignment, R_{1+2} extending just beyond this level as a scarcely apparent spur; radial veins very strongly deflected caudad; a supernumerary crossvein in each of cells R_3 and R_5, the former just beyond midlength, the latter just beyond one-third the length of cell.

Habitat.—New Guinea.

Holotype, a fragmentary male, Graget Island, May 1, 1901 (*Biró*).

There are only two described species of *Libnotes* having two supernumerary crossveins in the radial field of the wing (*regalis* Edwards, of Formosa; *diphragma* Alexander, of western China). The present fly differs notably from both of these flies in the pattern of the legs and wings. It should be noted that

the relative position of the supernumerary crossveins is nearly the same in all species (that in cell R_5 being far proximad of the one in cell R_3, more or less in transverse alignment with the basal section of M_3). I name this fine species in honor of my old friend and coworker on the Tipulidæ, Postamtrat M. P. Riedel.

LIMONIA (LIBNOTES) DJAMPANGENSIS sp. nov. Plate 1, fig. 10.

General coloration of thorax almost uniformly reddish brown; rostrum, palpi, and antennæ black; legs reddish brown, only the terminal tarsal segments brownish black; wings with a weak brownish tinge, cells C and Sc more strongly infumed; stigma virtually lacking; R_2 and free tip of Sc_2 nearly in transverse alignment; tips of outer radial veins only slightly decurved; Rs longer than cell 1st M_2, only moderately oblique; m and basal section of M_3 in transverse alignment; m-cu at near two-thirds the length of cell 1st M_2; abdomen reddish brown, the subterminal segments blackened; ovipositor with valves very short, the blackened cerci bifid at tips.

Female.—Length, about 15 millimeters; wing, 13.

Rostrum black, a little longer than the scape; palpi black. Antennæ black throughout; basal flagellar segments oval, the middle ones more cylindrical with long verticils that are fully twice the length of the segments; outermost segments even more elongate, the terminal segment nearly twice as long as the penultimate. Head dark gray, the anterior vertex immediately cephalad of the eyes more golden-yellow; posterior vertex with a median dark vitta; anterior vertex reduced to a hairlike line, the eyes actually contiguous for a distance.

Pronotum blackish above, more brown on sides. Mesonotum almost uniformly reddish brown, the humeral and lateral portions of præscutum vaguely darker. Pleura reddish brown. Halteres relatively long and slender, black, the bases narrowly yellow. Legs with the coxæ and trochanters reddish brown; remainder of legs reddish brown, the outer tarsal segments brownish black. Wings (Plate 1, fig. 10) with a weak brown tinge, cells C and Sc much more strongly infumed; stigma so small as to be virtually lacking, including a tiny cloud at point of union of free tip of Sc_2 and R_2; certain of the longitudinal veins, especially Cu and the anterior branch of Rs, narrowly seamed with brown; wing tip and entire apical and posterior border very narrowly bordered with brown; axilla restrictedly darkened; veins brownish black to black. Venation: Free tip of Sc_2 and R_2 almost in transverse alignment, the latter only moderately long; outer radial veins at margin only weakly de-

curved; Rs longer than cell 1st M_2, only moderately oblique; cell 1st M_2 elongate, m and basal section of M_3 subequal and in transverse alignment; m-cu at near two-thirds the length of cell; anal veins convergent.

Abdomen reddish brown, unmarked except for extensively blackened areas on segments seven to nine, segment eight entirely blackened. Ovipositor with valves very short, piceous, the cerci with the tips bifid by apical notches; hypovalvæ a little exceeding the cerci.

Habitat.—Western Java.

Holotype, female, Djampang Tengah, altitude 1,500 to 2,000 feet, March, 1933 (*M. E. Walsh*).

By Edwards's key to the species of *Libnotes*,[11] the present fly runs to those species included between couplets 28 and 53, disagreeing in characters with all species beyond couplet 29. It is most similar to species such as *Limonia* (*Libnotes*) *ferruginata* Edwards (Buru), *L.* (*L.*) *rufata* Edwards (North Borneo), and *L.* (*L.*) *simplex* (Osten Sacken) (Ternate and North Borneo), differing in the coloration of the body, legs, and wings, venational details, structure of the anterior vertex, and nature of the ovipositor.

LIMONIA (LIBNOTES) MOPSA sp. nov. Plate 1, fig. 11.

Allied to *nigricornis;* general coloration of mesonotal præscutum almost concealed by a brownish black dorsal shield, comprised of three confluent stripes; rostrum, palpi, and antennæ black throughout; legs brown; wings faintly tinged with brown, cells C and Sc, with the small stigma, darker brown; wing apex and posterior border as far back as vein Cu_1 very narrowly seamed with brown; Sc_2 at tip of Sc_1; veins beyond cord unusually long, the distal section of M_{1+2} nearly three times the second section; m-cu at midlength of cell 1st M_2.

Female.—Length, about 5 millimeters; wing, 5.3.

Rostrum and palpi black. Antennæ black throughout; flagellar segments with very short, glabrous, apical pedicels; terminal segment strongly narrowed on outer half, longer than penultimate; longest flagellar verticils only slightly exceeding the segments. Head dark gray, lighter gray in front; anterior vertex reduced to a linear strip.

Pronotum obscure yellow. Mesonotal præscutum with ground color almost concealed by three confluent brownish black stripes, the humeri and lateral borders broadly obscure yellow; poste-

[11] Journ. Fed. Malay St. Mus. 14 (1928) 74–80.

rior sclerites of notum almost uniformly dark brown. Pleura, especially the dorsal sclerites, infuscated. Halteres dark brown, the base of stem yellow. Legs with coxæ and trochanters obscure yellow; remainder of legs uniformly brown. Wings (Plate 1, fig. 11) with a faint brown tinge, cells C and Sc, together with the small inconspicuous stigma darker brown; wing apex and posterior border as far back as vein Cu_1 very narrowly and insensibly seamed with brown; veins dark brown. Venation: Sc_1 ending just beyond fork of Rs, Sc_2 at its tip; Rs long, gently arcuated; free tip of Sc_2 and R_2 both pale, in approximate transverse alignment; veins beyond cell 1st M_2 elongate, last section of M_{1+2} nearly three times the second section; M_4 a little longer than cell 1st M_2; m and basal section of M_3 both short and subequal; m-cu at midlength of cell 1st M_2, about two-thirds as long as the distal section of Cu_1; anal veins parallel at bases.

Abdominal tergites dark brown, the pleural region and sternites more yellowish; cerci small and slender; hypovalvæ blackened at bases.

Habitat.—New Guinea.

Holotype, female, Stephansort, Astrolabe Bay, 1900 (*Biró*). Paratopotype, female.

By Edwards's key to the species of *Libnotes*,[12] the present fly runs to *Limonia* (*Libnotes*) *nigricornis* (Alexander), of western Java, which is apparently still the nearest ally. The two flies agree in the general appearance but are readily told by the coloration of the thorax and by the venation, especially the long medial veins and short m of the present fly. The types earlier had been determined tentatively by Riedel [13] as being *Limonia* (*Geranomyia*) *argentifera* (de Meijere), which they superficially resemble, but in reality they pertain to the subgenus *Libnotes*, as described. Both specimens are females.

LIMONIA (IDIOGLOCHINA) FLAVALIS sp. nov. Plate 1, fig. 12; Plate 2, fig. 30.

General coloration of body, legs, halteres, and wings yellow; Sc unusually short, the distance on costa between tip of Sc_1 and the origin of Rs about equal to twice the length of the latter vein.

Male.—Length, about 5 to 6 millimeters; wing, 5.5 to 6.5.

Rostrum yellow, about one-half the remainder of head; palpi dark brown. Antennæ yellow, only the outer segments darkened;

[12] Loc. cit. [13] Ann. Mus. Nat. Hungarici 18 (1921) 131, No. 9.

flagellar segments with the lower face strongly produced, more accentuated on the intermediate segments. Head gray pruinose; anterior vertex about one-third wider than the diameter of scape; posterior vertex with indications of an impressed median line.

Pronotum brownish yellow. Mesonotum chiefly obscure yellow, the præscutum with the lateral brown stripes reddish brown, distinct; intermediate stripes much paler, scarcely darker than the ground, separated by a capillary pale vitta; mediotergite somewhat more darkened. Pleura reddish yellow, sparsely pruinose. Halteres yellow. Legs yellow, the terminal tarsal segments darker. Wings (Plate 1, fig. 12) yellow, the veins darker yellow. Both anal veins with macrotrichia at outer ends. Venation: Sc very short, the distance on costa between tip of Sc_1 and origin of Rs about equal to twice the length of the latter vein; R_1 and R_2 forming a common, gently arcuated vein, R_1 with three strong trichia, R_2 glabrous, m-cu at fork of M.

Abdominal tergites light yellowish brown; sternites and hypopygium yellow. Male hypopygium (Plate 2, fig. 30) with the setæ at apices of lobes of tergite, 9*t*, unusually strong and powerful.

Habitat.—New Guinea.

Holotype, male, Seleo, Berlinhafen, 1896 (*Biró*). Paratopotype, male.

Limonia (*Idioglochina*) *flavalis* is best characterized by the light yellow coloration of the body and appendages. The structure of the male hypopygium is remarkably uniform and monotonous throughout this entire group (*de-beauforti*) of the subgenus.

LIMONIA (ALEXANDRIARIA) CINEREICAPILLA sp. nov. Plate 1, fig. 13.

General coloration of entire body pale yellow or reddish yellow; outer flagellar segments darkened; legs and wings pale yellow; Sc short, Sc_1 ending far before origin of Rs, the distance on costa between the two veins about one-half longer than Rs alone; free tip of Sc_2 some distance before R_2; m-cu before fork of M, longer than distal section of Cu_1.

Female.—Length, about 6 millimeters; wing, 5.8.

Rostrum and palpi pale. Antennæ with basal four or five segments yellow, the remaining segments passing into dark brown; flagellar segments oval, the verticils about equal in length to the segments; terminal segment a little larger than the penultimate. Head entirely light silvery white.

Mesothorax entirely pale reddish yellow. Halteres pale yellow throughout. Legs pale yellow, the outer tarsal segments very faintly darkened. Wings (Plate 1, fig. 13) pale yellow, the costal border slightly more saturated; veins pale yellow. Macrotrichia of veins relatively numerous, including a series of four or five on basal half of Rs; all outer radial and medial branches with trichia. Venation: Sc short, Sc_1 ending far before origin of Rs, the distance on costa about one-half longer than Rs; Rs and basal section of R_{4+5} subequal and in approximate oblique alignment; free tip of Sc_2 some distance before R_2; m-cu before fork of M, longer than the distal section of Cu_1.

Abdomen uniformly pale reddish yellow. Cerci long and straight.

Habitat.—New Guinea.

Holotype, female, Seleo, Berlinhafen, 1896 (*Biró*).

I am under the belief that when the male sex of the present fly is discovered it will be found to belong to the subgenus *Idioglochina* rather than to *Alexandriaria* where it must now be referred. If the above belief is well founded, another subgenus of *Limonia* will be added to the list of groups in the genus showing this reduced venation of the medial field (at present including *Dicranomyia* Stephens and *Euglochina* Alexander). The present fly is readily told from the other regional species of *Alexandriaria* having a uniformly pale color by the entirely silvery white head.

HELIUS (HELIUS) SUBARCUARIUS sp. nov. Plate 1, fig. 14; Plate 2, fig. 31.

Allied to *arcuarius;* antennæ short; general coloration of mesonotal præscutum brownish black medially, paling to dark reddish brown on sides; dorsal pleural region dark brown, the ventral sclerites paler; legs brownish black, the extreme outer tarsal segments brownish white; wings dusky, the stigma and cells C and Sc dark brown; wing margin narrowly darkened; anterior branch of Rs not running close to R_1; cell 1st M_2 nearly three times as long as wide; male hypopygium with the mesal lobe of basistyle conspicuous; outer dististyle slender, the tip simple.

Male.—Length, including rostrum, about 5 millimeters; wing, 5.5.

Rostrum black, subequal in length to remainder of head; palpi black. Antennæ black throughout; flagellar segments short-cylindrical, with an abundant short erect pubescence; antennæ

(male) about as long as the head, including rostrum. Head blackish; anterior vertex reduced to a linear strip that is about equal in width to two ommatidia.

Pronotum dark brown. Mesonotal præscutum brownish black medially, paling on sides to dark reddish brown; lateral stripes not differentiated; posterior sclerites of notum dark brown, the median area of scutum and lateral portions of scutellum somewhat paler. Pleura with dorsal sclerites and all of pteropleurite and pleurotergite dark brown, the sternopleurite and meral region paling to testaceous-yellow. Halteres with stem dirty white, the knobs brown. Legs with fore coxæ dark brown, the remaining coxæ more testaceous-brown; trochanters testaceous; femora brownish black, the bases narrowly pale; remainder of legs black, the extreme outer tarsal segments paling to brownish white. Wings (Plate 1, fig. 14) with a dusky tinge, cells C and Sc, together with stigma, dark brown; outer margin of radial field to wing apex narrowly darkened, the color continued as an even narrower seam to opposite end of vein 2d A; veins black. Venation: Basal section of R_{4+5} subequal to r-m; anterior branch of Rs not strongly arcuated and running close to R_1, as is the case in *arcuarius;* cell 1st M_2 long and relatively narrow, nearly three times as long as wide; m-cu about one-half its length beyond the fork of M; m-cu about one-half the distal section of Cu_1.

Abdominal tergites dark brown; sternites obscure brownish yellow. Male hypopygium (Plate 2, fig. 31) with the mesal lobe of basistyle, *b*, large and conspicuous, with spinous setæ. Outer dististyle, *od*, slender, gently curved, the tip simple. Interbase, *i*, with base dilated, the apex greatly produced into a long curved spine, which, on distal third, bears a nearly hyaline flange back from tip.

Habitat.—Western Java.

Holotype, male, Djampangs, altitude 1,500 to 2,000 feet, August, 1933 (*M. E. Walsh*).

The nearest ally of the present fly seems to be *Helius* (*Helius*) *arcuarius* Alexander (Luzon). This latter species differs in the even more arcuated anterior branch of Rs, which is nearly perpendicular to a point opposite the fork of Sc, thence running parallel and very close to R_1. The hypopygial details, especially the shorter and stouter outer dististyle, and the stout mesal lobe of the basistyle, are similarly distinct.

HEXATOMINI

LIMNOPHILA (ELÆOPHILA) MARMOREA sp. nov. Plate 1, fig. 15; Plate 2, fig. 32.

General coloration dark brown, variegated with gray; femora yellow, the tips vaguely darkened; wings (male) broad, with a heavy dark pattern, including a broad, continuous band at cord that is interrupted only by a small pale area beyond tip of vein Sc; major dark areas in costal field wider than the interspaces, beyond the cord inclosing only single darkened spots; male hypopygium with the outer dististyle bearing a slender lobule on outer margin.

Male.—Length, about 5 millimeters; wing, 5.5 by 1.8.

Rostrum and palpi black. Antennæ broken. Head gray.

Pronotum dark brown, heavily pruinose. Mesonotal præscutum with the ground color grayish brown, the lateral borders broadly and conspicuously dark brown; posterior ends of lateral and intermediate stripes indicated by narrow dark lines before suture; interspaces with a series of four or five dark dots extending from the suture cephalad; scutal lobes variegated with pale; posterior sclerites of notum blackish, the mediotergite with paler pollinose areas. Pleura dark, variegated by silvery and grayish areas. Halteres broken. Legs with the coxæ blackened; trochanters yellow; femora yellow, with faint indications of a darker subterminal ring, best delimited internally; tibiæ and tarsi yellow, the terminal segments of the latter darkened. Wings (Plate 1, fig. 15) broad (male), whitish subhyaline, with a very heavy, dark brown, banded and dotted pattern, including major areas and crossbands beyond arculus; a complete parallel-sided band at level of origin of Rs; a complete band at cord, expanded at cephalic end and broken only by a small pale area in cell Sc_1 beyond the fork of vein Sc; large areas at wing tip and at end of vein R_3; outer end of cell 1st M_2 darkened; abundant dots in all the interspaces; veins yellow, darker in the clouded areas. Costal fringe short. Venation: Sc_1 ending just beyond fork of Rs, Sc_2 near its tip; cell 1st M_2 large, with m-cu at near one-fifth its length; supernumerary crossvein opposite origin of Rs.

Abdomen brownish black. Male hypopygium (Plate 2, fig. 32) with the outer dististyle, *od*, bearing a slender lobule on outer margin, more basad than the numerous spinules before the apical spine; apical notch oval. Phallosomic armature, *p*, relatively conspicuous.

Habitat.—Western Java.

Holotype, male, Soekaboemi, altitude 1,800 feet, March 8, 1933 (*M. E. Walsh*).

In its small size, the present fly suggests *Limnophila* (*Elæophila*) *dietziana* Alexander (Japan) and *L.* (*E.*) *serrulata* Alexander (western China). It is more nearly allied to the larger *L.* (*E.*) *granulata* Edwards (North Borneo), which likewise has the wings of the male greatly dilated opposite the termination of vein 2d A. The present fly has the dark wing pattern much heavier, restricting the ground color, more conspicuously so in the costal and apical fields. The darkened femoral rings are very much reduced and the male hypopygium is slightly different.

HEXATOMA (ERIOCERA) MALANGENSIS sp. nov. Plate 1, fig. 16.

Belongs to the *nepalensis* group; mesonotum deep velvety black, opaque; antennal flagellum extensively yellow; legs black, the femoral bases broadly yellow; an extensive elongate-oval white area before cord; no macrotrichia on Rs, R_{2+3+4}, or R_3; R_2 very oblique in position; inner end of cell 1st M_2 strongly arcuated, m-cu close to its outer end; abdomen black throughout; tergites one to five shiny, the narrow caudal borders opaque.

Female.—Length, about 16 millimeters; wing, 12.

Rostrum and palpi black. Antennæ (female) 10-segmented; scape and pedicel black; flagellar segments one to four light yellow; succeeding segments brownish black; basal flagellar segments with long coarse verticils on all faces. Head black.

Mesonotum and pleura entirely deep velvety black, opaque. Halteres short, black throughout. Legs with the coxæ and trochanters black; remainder of legs black, the femoral bases broadly yellow, on fore legs including a little more than basal half, on midlegs approximately the basal two-thirds, on posterior legs a little more than the basal three-fourths. Wings (Plate 1, fig. 16) dark brown, the prearcular and adjoining regions conspicuously bright yellow, the extreme wing base again narrowly blackened; an elongate-oval white area before cord, extending from vein R_1 to 2d A, widest in cell R; veins dark brown, yellow in the pale areas. No macrotrichia on Rs, R_{2+3+4}, or R_3; sparse but conspicuous trichia on outer sections of M_{1+2} and M_3. Venation: Sc_1 ending beyond distal end of R_2, Sc_2 far from its tip; R_2 very oblique in position, R_{2+3} short; inner end of cell 1st M_2 strongly arcuated, with m-cu close to its outer end.

Abdomen black throughout, tergites one to five shiny except for narrow caudal margins, the succeeding segments opaque

black; genital shields black; ovipositor with valves elongate, the cerci blackened at bases, slender.

Habitat.—Western Java.

Holotype, female, Goenoeng Malang, Djampangs, altitude 3,000 feet, July 10, 1933 (*M. E. Walsh*).

The four Javanese species that show the following group characters are separated by the key that follows:

Mesothorax opaque velvety black, unmarked (blue-gray in *diengensis* type, this possibly due to immersion in spirit). Wings with cell M_1 lacking. Base of wing yellow; a conspicuous whitish area before cord; no white or yellow areas on wing beyond cord.

Key to Javanese species of Hexatoma.

1. Cell 1st M_2 small, its inner end only slightly arcuated, m-cu at midlength; distal section of Cu_1 nearly two times m-cu; antennal flagellum black. *diengensis* Alexander.

   Cell 1st M_2 with its inner end arcuated, lying nearly as far basad as inner end of cell R_4; m-cu near outer end of cell 1st M_2; distal section of Cu_1 subequal to m-cu; antennal flagellum either black or yellow.... 2.

2. R_2 very oblique in position, at or close to fork of R_{2+3+4}; antennal flagellum chiefly light yellow..... 3.

   R_2 subtransverse, subequal to R_{2+3}; antennal flagellum black. *atricornis* sp. nov.

3. Abdomen with segments two to five conspicuously yellow; vein R_3 with macrotrichia ..... *salakensis* Edwards.

   Abdomen black throughout, the basal portions of tergites one to five shiny, the margins opaque; vein R_3 without macrotrichia. *malangensis* sp. nov.

HEXATOMA (ERIOCERA) ATRICORNIS sp. nov. Plate 1, fig. 17.

Belongs to the *nepalensis* group; mesonotum deep velvety black, opaque; antennæ black throughout, 11-segmented (female); legs black, the femoral bases yellow; wings broad, intensely blackened, the prearcular cells narrowly yellow; a conspicuous white discal area before cord; an abundant series of macrotrichia on vein R_3; R_2 subequal in length to R_{2+3}, subtransverse; inner end of cell 1st M_2 strongly arcuated; abdomen entirely black, the incisures of the tergites opaque, the intermediate portions polished; genital shield entirely opaque black.

Female.—Length, about 18 millimeters; wing, 14.

Rostrum and palpi black. Antennæ black throughout, 11-segmented (female); flagellar segments gradually decreasing in length to the fifth, the succeeding three subequal; terminal segment scarcely one-half longer than penultimate; flagellar seg-

ments with long coarse setæ, distributed on all faces. Head dark blackish gray; anterior vertex very wide.

Mesonotum and pleura entirely deep velvety black. Halteres short, black throughout. Legs with coxæ and trochanters black; remainder of legs black, the femoral bases obscure yellow, narrowest on forelegs where about one-fifth is included, broader on the middle and hind legs where one-fourth to nearly one-third is brightened. Wings (Plate 1, fig. 17) broad, the ground color intensely blackened; prearcular region to just beyond level of h bright yellow, the extreme base again darkened; an irregularly oval white discal area, extending from cell R_1 to cell M, widest in cells R and M, narrowest in cell R_1 where it does not reach vein R_1; anal cells a trifle paler than the remainder of the darkened ground; veins black, a trifle paler in the white discal area, light yellow in the prearcular field. Macrotrichia of veins relatively abundant, including complete series on R_3 (about 35 to 40), on R_{2+3} (about 6), and on R_{2+3+4}; M, Cu, and 1st A, with all branches, glabrous. Venation: Sc_1 extending to shortly beyond R_2, Sc_1 long; R_2 fully its own length beyond fork of R_{2+3+4} and thus subequal to R_{2+3}, subtransverse in position, without trichia; inner end of cell 1st M_2 strongly arcuated; m-cu at outer end of cell, subequal to or slightly longer than the distal section of Cu_1.

Abdomen entirely black, the bases of tergites broadly shiny black to nacreous, the apical third or fourth opaque velvety black, the extreme bases of segments similarly opaque; sternites opaque black; genital shield entirely opaque black; ovipositor with valves black, the tips narrowly brown.

Habitat.—Western Java.

Holotype, female, Djampangs, altitude 1,500 to 2,000 feet, May, 1933 (*M. E. Walsh*).

The relationships of the present fly have been discussed under the preceding species.

HEXATOMA (ERIOCERA) SALAKENSIS (Edwards).

Eriocera salakensis EDWARDS, Treubia 6 (1925) 167–168.

Described from a single female, taken at Tjitjoeroek, Salak, western Java, altitude 3,250 feet, March 6, 1921 (*Karny*).

A male is before me, herewith characterized as allotype.

Male.—Length, about 18 millimeters; wing, 13.

Characters as in female, as described by Edwards, with the following differences: Antennal flagellum, excepting outer segments, light yellow. Wings with the very oblique R_2 at or just

before fork of R_{2+3+4}. Abdomen relatively long for the male sex, somewhat as in *acrostacta*.

Allotype, male, Selabintanah, Mount Gedeh, western Java, altitude 3,000 feet, December, 1932 (*M. E. Walsh*).

HEXATOMA (ERIOCERA) BENGALENSIS CONSTRICTA subsp. nov.

Limnophila bicolor MACQUART, Dipt. exot. 1 (1838) 66, pl. 7, fig. 2.
Eriocera bicolor VAN DER WULP, Mid-Sumatra Exped., Diptera (1892) 11, pl. 1, figs. 5–6.
Eriocera bicolor DE MEIJERE, Tijd. voor Ent. 54 (1911) 57–58.
Hexatoma (*Eriocera*) *bengalensis* ALEXANDER, Philip. Journ. Sci. 52 (1933) 148 (renaming of *bicolor*, preoccupied).

Female.—Length, about 15 millimeters; wing, 12.

Rostrum and palpi dark. Antennæ black, the scape pruinose; extreme base of first flagellar segment pale yellow; 10-segmented (female), segments gradually decreasing in length to the penultimate; last segments about one-fourth longer than the penultimate.

Mesonotal præscutum with the ground color gray, with a narrow velvety black median vitta that is dilated on anterior half of sclerite, on posterior half constricted into a mere line; the usual four præscutal stripes are more plumbeous, faintly shiny; posterior interspaces feebly dusted with gray; a large circular velvety black spot on margin of præscutum, in the region of the pseudosutural fovea. Halteres short, black throughout. Legs with coxæ and trochanters blackish, pruinose; femora chiefly black, the bases restrictedly obscure yellow, more evident on fore femora; tibiæ and tarsi black. Wings with the broad discal band slightly widened behind, extending from vein R to posterior margin; cells C and Sc more brownish yellow than remainder of wing; entire basal third of wing darkened, excepting the broad proximal ends of both anal cells. Venation: R_{2+3+4} and R_{2+3} subequal, both shorter than basal section of R_5; R_2 transverse, about one-third R_{2+3}; m-cu at near three-fourths the length of cell 1st M_2; cell M_1 present, subequal in length to its petiole.

Basal abdominal tergite velvety black on disk, bordered by orange; segments two and three orange; segments four to six, inclusive, black, the extreme bases, especially laterally, obscure orange; seventh and succeeding segments, including genital shield, orange.

Habitat.—Western Java.

Holotype, female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*M. E. Walsh*).

The type specimen of *bicolor* (*bengalensis*) came from Bengal. I am by no means convinced that the Javan specimens also referred to *bengalensis* really belong here. The present fly differs from other Javan and Sumatran material that has been referred to this species in the increase in dark color at the wing base, restricting the pale yellow of this field to the proximal ends of the anal cells.

Macquart's description of his *bicolor* indicates a species with the basal three abdominal segments fulvous-orange, the remaining segments black with only the valves of the ovipositor fulvous. Moreover, his figure and description of the pattern of the mesonotum differs in several important regards from that of the present fly. Van der Wulp [14] indicates that certain specimens occur in which the costal cell is darker brown than in normal individuals, which have the costal field yellow like the basal and discal bands.

GYNOPLISTIA (GYNOPLISTIA) BIRÓANA sp. nov. Plate 1, fig. 18; Plate 2, fig. 33.

Mesothorax black, the pteropleurite conspicuously silvery; halteres black, the base of stem obscure reddish; femora yellow, the extreme tips darkened; tibiæ brownish black, the posterior tibiæ more brownish yellow with darkened tips; wings with the ground color light yellow, the prearcular and costal regions clear yellow; four transverse brown fasciæ, the basal two narrow and interrupted, the outer two, including the cord and apex, very broad and continuous, almost confluent with one another; macrotrichia of veins beyond cord sparse; cell M_1 present, deep; cell 1st M_2 small; abdomen with basal tergite darkened, segments two to four bright orange; remaining segments purplish black; median region of tergite of male hypopygium produced caudad into a narrow lobe; a single simple dististyle.

Male.—Length, about 11 millimeters; wing, 10.

Rostrum and palpi light yellow. Antennæ broken. Posterior portions of head entirely light yellow.

Pronotum and propleura velvety black. Mesonotum brownish black, with faint reddish tinges. Pleura black, the pteropleurite dusted with silvery throughout its entire length. Halteres black, the extreme bases of stems obscure reddish. Legs with the coxæ and trochanters black; femora light yellow, the tips very narrowly darkened; tibiæ and tarsi brownish black, the posterior tibiæ more brownish yellow, the tips darker; tarsi relatively short, brownish black. Wings (Plate 1, fig. 18) with the ground

[14] Loc. cit.

color light yellow, the prearcular and costal regions clearer yellow; four transverse brown fasciæ, the basal pair narrow, the outer pair very broad and almost confluent; basal fascia postarcular in position, interrupted in cubital field, not crossing R; second band at origin of Rs, extending from R to M, broadly interrupted in cell M, recurring in cells Cu and 1st A; the broad outer bands include the cord and apex, confluent except for vague indications of pale washes at their union, the band at cord somewhat more suffused; veins brown, luteous in the yellow costal and prearcular fields. Macrotrichia of veins relatively sparse, there being two on R_3, six or seven on M_1, lacking elsewhere on veins M, Cu, or anals; costal setæ at wing base very long and conspicuous. Venation: Basal section of R_5 long and gently arcuated; cell M_1 deep, about one-half longer than its petiole; cell 1st M_2 small, its inner end slightly arcuated; m-cu at about one-fourth the length of the cell; vein 2d A strongly sinuous.

Abdomen with basal tergite darkened; segments two to four, inclusive, bright orange; remainder of abdomen, including hypopygium, purplish black. Male hypopygium (Plate 2, fig. 33) with the median area of tergite, 9*t*, produced caudad into a narrow median lobe, its tip gently notched. Apex of basistyle, *b*, produced into a small acute spine and a longer straight rod; a single dististyle, *d*, its basal portion straight, before apex suddenly narrowed.

Habitat.—New Guinea.

Holotype, male, Simbang, Huon Gulf, 1899 (*Biró*).

This fine species is named in honor of the collector, Ludwig Biró, whose name will always be associated with notable discoveries in Papua. It is most generally similar to two other species from New Guinea, *Gynoplistia* (*Gynoplistia*) *fulviceps* Walker (northwest) and *G.* (*G.*) *nigrithorax* Alexander (southeast), agreeing in the brightly colored head and darkened thorax, differing from the former in the large size, coloration of the legs, and in the wing pattern, as the conspicuous bright yellow costal field. From the latter species, it differs in the coloration of the head, uniformly darkened thoracic pleura, coloration of legs, and the different wing pattern, especially the pale and broken basal bands. The type specimen had earlier been recorded [15] as doubtfully being *fulviceps*, which it rather

[15] Riedel, Ann. Mus. Nat. Hungarici 18 (1921) 137.

closely resembles. The two badly preserved females of the same species mentioned by Riedel were not sent to me.

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) AURICOSTA sp. nov. Plate 1, fig. 19.

General coloration of thorax bright orange, the præscutum and pleura immaculate; antennæ black; scutellum black; mediotergite blackened, with a transverse yellow line at near midlength; apices of knobs of halteres yellow; legs brown to brownish black, the tips of fore and middle tibiæ and all tarsi light yellow; all femora with a basal series of small spines; wings whitish subhyaline, the costal region light yellow; apex of wing narrowly darkened; m-cu at fork of M; abdominal tergites black; sternites obscure yellow, blackened medially, the intermediate sternites chiefly pale; genital segment (female) orange.

Female.—Length, about 10 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments long-cylindrical, with short verticils. Head light gray; posterior vertex with median carina; eyes opposite anterior vertex separated by a line narrower than the carina.

Cervical region brown. Pronotum and mesonotal præscutum bright orange, immaculate; scutal lobes blackened on mesal portions, the more lateral parts obscure orange; scutellum black; mediotergite chiefly blackened, yellowish laterally, with a narrow obscure yellow line across the sclerite at midlength. Pleura orange, more polished than the notum. Halteres with basal half of stem light yellow; outer half of stem and base of knob black; apex of knob conspicuously light yellow. Legs with coxæ and trochanters yellow; femora brown, passing into dark brown or brownish black on outer ends; tibiæ dark brown, the tips paler, very broadly so on fore legs, more obscurely on posterior legs; fore and middle tarsi light yellow, posterior tarsi more obscured. Fore and middle femora near base with a series of about a dozen small erect black spines; posterior femora with three or four shorter spines; posterior tibiæ before tips with four or five strong black setæ among the other vestiture. Wings (Plate 1, fig. 19) whitish subhyaline, cells C and Sc clear light yellow; stigma dark brown; a paler brown wash from stigma around margin to wing tip; a broad dark brown seam along vein Cu in cell M; narrower and less evident dark seams along Rs, R_2, R_{3+4}, and distal section of R_5; a darkened spot at point of divergence of anal veins; veins black, C, Sc, and R light

yellow. Venation: Rs elongate, exceeding R_{2+3+4}; vein R_3 suberect and sinuous, cell R_3 very wide at base; m-cu at fork of M; apical fusion of veins Cu_1 and 1st A slight but distinct.

Abdominal tergites black, narrowly bordered laterally with obscure yellow; sternites obscure yellow, blackened medially, the fourth and fifth sternites chiefly pale; sixth to eighth sternites, inclusive, entirely and intensely blackened; genital segment orange; ovipositor with cerci pale horn color.

Habitat.—Western Java.

Holotype, female, Bibidjilan, Djampangs, altitude 2,000 feet, September, 1933 (*M. E. Walsh*).

The nearest ally of the present fly is *Trentepohlia* (*Mongoma*) *flavicollis* Edwards, likewise from western Java. The latter species is before me (Djampangs, western Java, July, 1933, *Walsh*). The apices of the knobs of the halteres are orange, a character not mentioned by Edwards. Both of these species are separable from *cariniceps* and its near allies by the smaller physical size and by the position of m-cu at or very close to the fork of M.

TRENTEPOHLIA (MONGOMA) AURANTICOLOR sp. nov. Plate 1, fig. 20.

Belongs to the *cariniceps* group; mesonotum and pleura clear yellow to orange-yellow; rostrum light yellow; head brownish yellow; halteres strongly infumed, the basal portion of stem yellow; legs light brown, the tarsal segments more yellowish; wings whitish subhyaline, the prearcular and costal regions clear light yellow; stigma lacking; veins dark; inner end of cell M_3 lying far basad of cells R_5 and 2d M_2; m-cu at or only a short distance beyond the fork of M; veins Cu_1 and 1st A narrowly separated at margin; abdominal tergites obscure yellow, with a conspicuous dark brown median stripe that is narrowly interrupted at the incisures; genital segment chiefly pale.

Female.—Length, about 13 millimeters; wing, 9.

Rostrum and palpi light yellow. Antennæ yellow, the outer segments a trifle more obscure; flagellar segments of outer half of organ with a powerfully developed black seta on lower face, on tenth to twelfth segments of flagellum these considerably exceeding the segments in length; on more basal segments these setæ gradually shorter and less differentiated from the remaining setæ. Head brownish yellow, the postvertical carina conspicuous.

Cervical sclerites, pronotum, mesonotum, and pleura entirely bright yellow to orange-yellow. Halteres strongly infumed, the

basal portion of stem light yellow. Legs unusually long and powerful, as in the group; coxæ and trochanters light yellow; remainder of legs chiefly light brown or brownish yellow, the femoral bases clearer yellow; femoral tips narrowly and insensibly brightened; outer tarsal segments yellow; posterior and middle femora with the usual black spines at bases; posterior tibiæ with three powerful black setæ near tip. Wings (Plate 1, fig. 20) whitish subhyaline, the prearcular and costal regions clear light yellow; stigma lacking; veins dark brown, those in the yellow areas more luteous. Venation: Rs a trifle longer than basal section of R_5; R_2 nearly equal in length to R_{3+4}; vein R_4 only moderately decurved at outer end; inner ends of cells R_5 and 2d M_2 nearly in transverse alignment, of cell M_3 lying far proximad; m-cu at or only a short distance beyond fork of M; veins Cu_1 and 1st A distinctly separate at margin.

Abdominal tergites obscure yellow, with a conspicuous dark brown or brownish black median stripe that is narrowly interrupted at the bases of the segments; sternites chiefly obscure yellow; genital segment darkened medially above, the apex and lateral portions yellow; cerci reddish horn color.

Habitat.—Western Java.

Holotype, female, Selabintanah, Mount Gedeh, altitude 3,000 feet, April 15, 1933 (*M. E. Walsh*).

The regional members of the *cariniceps* group may be separated by the key accompanying the following group discussion.

The species are all of large to very large size; mesothorax yellow or orange-yellow, immaculate; median carina of posterior vertex conspicuous. The bases of femora in most species have series of few to many black spinous points arranged in a single, or, more rarely, a double row, while the posterior tibiæ before tips often have a series of long slender setæ arranged in a single series. The apical fusion of veins Cu_1 and 1st A is often very slight or lacking, and this character is apparently slightly variable within the limits of a single species.

Key to species of the cariniceps group.

1. Veins Cu_1 and 1st A distinctly separate at margin ..... 2.
   Veins Cu_1 and 1st A slightly fused backward from margin ..... 5.
2. All femora with spines near base ..... 3.
   No spines on fore femora ..... 4.
3. Head chiefly black; flagellar segments each with two dorsal setæ; mesosternum with a group of black bristles on either side of mid-line (North Borneo) ..... *spiculata* Edwards.

Head ocherous; flagellar segments each with one longer dorsal seta; mesosternum bare or with inconspicuous pale setæ only (North Borneo) ..... *lutescens* Edwards.

4. Outer costal region strongly infumed; m-cu its own length or more beyond fork of M; Cu_1 and 1st A widely separated at margin; genital shield (female) blackened (Western Java) ..... *separata* sp. nov.

Prearcular and costal regions clear light yellow; m-cu at or only a short distance beyond fork of M; Cu_1 and 1st A narrowly separate at margin; genital shield (female) chiefly pale (Western Java). *auranticolor* sp. nov.

5. Head black ..... 6.

Head ocherous ..... 8.

6. Wing veins pale; abdomen uniformly yellow (Mentawi Islands, Western Sumatra) ..... *siporensis* Edwards.

At least some of the wing veins darkened; abdominal tergites more or less darkened ..... 7.

7. Stigmal area small or lacking; legs brown, the tarsi paler, more yellowish brown (Sumatra) ..... *nigriceps* de Meijere.

Stigma distinct; legs ocherous (North Borneo) ..... *spiculata* Edwards.

8. No spines at bases of femora (Sumatra and North Borneo). *cariniceps* Enderlein.

At least the hind femora with spines ..... 9.

9. Mesonotum dull, pleura shiny; all femora armed basally with spines, these numerous, ten to twenty in number; abdominal sternites dark (North Borneo) ..... *spiculata* Edwards.

Both mesonotum and pleura shiny; only the posterior femora with spines, these only three or four in number; abdominal sternites ocherous (North Borneo) ..... *fortis* Edwards.

I have included *lutescens* and *spiculata* in two places in the above key, the character of the apical fusion of veins Cu_1 and 1st A apparently being variable in these instances.

TRENTEPOHLIA (MONGOMA) SEPARATA sp. nov. Plate 1, fig. 21.

Belongs to the *cariniceps* group; mesonotum and pleura yellow; rostrum obscure yellow; head brown; halteres, including knobs, dusky; legs light brown, the outer tarsal segments paling to yellow; wings whitish subhyaline, the stigma and outer three-fourths of cells C and Sc infumed; vein R_4 long and sinuous, strongly decurved at outer end; m-cu its own length, or more, beyond the fork of M; veins Cu_1 and 1st A distinctly separated at margin; abdominal tergites with a broad, continuous, dark brown, median stripe; sternites yellow; dorsal shield of ovipositor blackened.

Female.—Length, about 12 to 13 millimeters; wing, 9.5 to 10.

Rostrum obscure yellow; palpi yellow, the terminal segment darkened. Antennæ with scape and pedicel light yellow; flagel-

lum brown; flagellar segments cylindrical, with short verticils, none exceeding the segments in length. Head brown; anterior vertex reduced to a narrow stripe; carina on posterior vertex relatively low and indistinct.

Cervical sclerites brownish yellow. Pronotum and mesonotum yellow, the posterior sclerites of the latter more obscure. Pleura yellow. Halteres dusky, the base of stem yellow. Legs with the coxæ orange-yellow; trochanters yellow; femora yellow basally, passing into brown, the tips again narrowly and insensibly brightened; tibiæ and basitarsi light brown, the outer tarsal segments paling to yellow; middle and hind femora with a series of eight to ten erect black spines near base; fore femora with these spines reduced to weak setæ, little evident; posterior tibiæ near tips with a series of about four black setæ, differentiated from the remaining vestiture. Wings (Plate 1, fig. 21) whitish subhyaline; stigma and outer three-fourths of cells C and Sc infumed, the basal fourth light yellow; wing tip narrowly and insensibly darkened; veins brown. Venation: R_2 a little longer than R_{3+4}; vein R_4 long and sinuous, strongly decurved on outer fourth, cell R_3 thus very wide; inner ends of cells R_5 and M_3 a little more proximad than that of cell 2d M_2 and about in alignment with one another; m-cu its own length or more beyond fork of M; veins Cu_1 and 1st A distinctly separated at margin, the distance a little shorter than m.

Abdominal tergites broadly and conspicuously dark brown, the lateral borders obscure yellow, the caudal borders very narrowly and insensibly pale, scarcely breaking the dorsal vitta; sternites yellow, the subterminal segments darkened; tergal shield of ovipositor blackened; cerci horn-colored, strongly upcurved.

Habitat.—Western Java.

Holotype, female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*M. E. Walsh*). Paratopotype, female.

Trentepohlia (*Mongoma*) *separata* is told from other allied species of the *cariniceps* group by the key provided with the preceding species. The Javanese record of *cariniceps* [16] is erroneous and refers either to the present fly or some closely allied form.

GONOMYIA (LIPOPHLEPS) WALSHÆ sp. nov. Plate 1, fig. 22.

Mesonotum reddish brown to brown; pleura obscure brownish yellow, with a longitudinal white stripe, bordered above and below by narrow brownish lines; legs brown, the femora unva-

[16] Alexander, Proc. U. S. Nat. Mus. 49 (1915) 173.

riegated; wings uniformly pale brown; costal region clear light yellow; stigma barely indicated; Sc relatively short; abdominal tergites with brown discal triangles, the posterior lateral angles conspicuously yellow.

Female.—Length, about 4.5 millimeters; wing, 4.2.

Rostrum and palpi black. Antennæ with scape and pedicel yellow above, darker beneath; flagellum black. Head above chiefly yellow.

Pronotum and anterior lateral pretergites light yellow. Mesonotum reddish brown, darker brown on disk, the median region even darker; scutal lobes infuscated, the median region yellow with a dusky line; scutellum dark brown, the caudal margin paler; mediotergite brownish gray, paler laterally. Pleura obscure brownish yellow, with an unusually distinct and clearly defined pure white longitudinal stripe, extending from behind the fore coxæ to the base of abdomen, bordered both above and beneath by darker brown, the latter broader, on sternopleurite. Halteres chiefly yellow. Legs with the fore coxæ darkened, mid- and hind-coxæ testaceous-yellow with only the extreme bases darkened; trochanters brownish yellow; remainder of legs brown, the femora entirely unvariegated; terminal tarsal segments blackened. Wings (Plate 1, fig. 22) with a uniform pale brown tinge, unvariegated by darker or paler areas; costal border clear light yellow; stigma long and narrow but scarcely darker in color than the ground; extremely vague indications of a dusky streak in center of cell R_4; axillary region weakly darkened; veins pale brown, Sc light yellow. Macrotrichia of veins relatively abundant, including a series along the entire length of the anterior branch of Rs and on Rs itself except at extreme base; complete series on all branches of M and Cu beyond cord, and at tips of both anal veins. Venation: Sc relatively short, Sc_1 ending a distance before origin of Rs that is a little shorter than r-m; anterior branch of Rs long and nearly straight; m-cu about one-third its length before fork of M.

Abdominal tergites with the disk of each segment chiefly covered by a brown triangle, the point directed behind leaving the narrow lateral margins and broad caudal-lateral angles yellow; sternites obscure yellow, with a dark median line.

Habitat.—Western Java.

Holotype, female, Soekaboemi, altitude 1,800 feet, June 1, 1933 (*M. E. Walsh*).

I take unusual pleasure in naming this species in honor of the collector, Mrs. M. E. Walsh. By Edwards's key to the Orien-

tal species of *Lipophleps*,[17] the present fly runs to *Gonomyia* (*Lipophleps*) *flavomarginata* Brunetti. I have before me for comparison a specimen of this latter species, determined by Edwards. It has broader wings that are evidently variegated by dark and light areas; anterior branch of Rs shorter and more divergent from the posterior branch, without macrotrichia. Edwards [18] supplies some additional significant data concerning Brunetti's paratypes.

ERIOPTERA (METERIOPTERA) SZILADYI sp. nov. Plate 1, fig. 23; Plate 2, fig. 34.

General coloration brownish yellow; halteres with brownish black knobs; legs yellow; wings tinged with brownish; vein 2d A nearly straight; abdomen brownish yellow, with a dark brown subterminal ring; male hypopygium with the outer dististyle a simple pale rod, its blackened apex with a comb of teeth.

Male.—Length, about 4.5 millimeters; wing, about 5.

Rostrum and palpi dark. Antennæ with scape and pedicel obscure yellow; six basal flagellar segments dark brown, each truncate-fusiform; longest verticils subequal to the segments. Head in the unique type apparently dark-colored.

Pronotum testaceous-yellow. Mesonotum brownish yellow, the præscutum with a faint and narrow brownish median line; central portion of scutum restrictedly darkened; cephalic half of mediotergite darkened, the posterior half pale. Pleura pale yellow. Halteres yellow, the knobs brownish black. Legs with the coxæ and trochanters pale yellow; remainder of legs yellow, only the outer two tarsal segments darkened. Wings (Plate 1, fig. 23) relatively narrow, tinged with brownish; veins and macrotrichia darker. Venation: Sc_1 ending opposite fork of Rs, Sc_2 just beyond origin of Rs; veins beyond cord almost straight, the extreme tip of Cu_1 deflected slightly cephalad; anal veins divergent, vein 2d A very weakly sinuous at extreme tip only, cell 1st A widest at margin.

Abdominal tergites obscure brownish yellow, the sternites a trifle paler; subterminal segments dark brown, the hypopygium light yellow. Male hypopygium (Plate 2, fig. 34) with the apical lobe of basistyle, *b*, slender. Outer dististyle, *od*, a simple pale rod, nearly straight to very gently arcuate, the apex oblique, blackened, with a comb of seven or eight teeth. Inner dististyle, *id*, entirely pale, expanded at apex into a conspicuous head,

[17] Journ. Fed. Malay St. Mus. 14 (1928) 104–105.
[18] Rec. Indian Mus. 26 (1924) 301.

the outer angle narrowed into a spine, near the apex of head with several weak tubercles.

Habitat.—New Guinea.

Holotype, male, Sattelberg (Sattelberg), Huon Gulf, September 20 to 30, 1898 (*Biró*).

I take great pleasure in dedicating this very distinct fly to Dr. Z. Szilady, custodian of the Diptera in the Hungarian National Museum. In the poorly preserved material available, I cannot detect a fusion segment at the base of the antennal flagellum but from the venation and structure of the male hypopygium, I believe the present fly to be correctly referred to the subgenus *Meterioptera*. In the simple outer dististyle of the hypopygium it is more nearly allied to the group of species that centers about *Erioptera* (*Meterioptera*) *javanensis* de Meijere than to those near *E.* (*M.*) *notata* de Meijere. The plain yellow legs and coarsely toothed apex of the outer dististyle furnish quite distinct characters from those of other described members of the *javanensis* group.

TOXORHINA (CERATOCHEILUS) BIRÓI sp. nov. Plate 1, fig. 24; Plate 2, fig. 35.

General coloration dark brown, pruinose; præscutum with three scarcely delimited brown stripes; wings with a faint brown tinge, cell Sc more infumed; anterior branch of Rs sinuous, nearly perpendicular; cell 1st M_2 open by atrophy of m; abdominal segments uniformly dark brown; male hypopygium with two dististyles, the outer simple, entire; mesal face of basistyle with a densely setiferous cushion; arms of ædeagus long.

Male.—Length, excluding rostrum, about 4.5 millimeters; wing, 5.

Rostrum broken off at extreme base. Antennæ with scape and pedicel light yellow; flagellum broken. Head gray, with conspicuous black setæ on posterior vertex; anterior vertex a little narrower than diameter of scape.

Mesonotum almost uniformly brown, the posterior sclerites somewhat darker and more pruinose than the præscutum, the latter with the ground color gray, with three very poorly delimited dark brown stripes. Pleura chiefly pale brownish yellow, the propleura and anepisternum a little darker, the pteropleurite and pleurotergite pale. Halteres dusky, the base of stem yellow. Legs with the coxæ obscure yellow, weakly infumed basally; trochanters testaceous; remainder of legs broken. Wings (Plate 1, fig. 24) with a faint brownish tinge, cell Sc more infumed

but with cell C undarkened; veins brown. Macrotrichia throughout entire length of Rs and its posterior branch; nearly complete dense series on outer sections of vein M_{1+2} and M_3. Venation: Anterior branch of Rs sinuous but nearly perpendicular, the distance on costa between it and tip of R_{1+2} less than the length of the vein itself; Sc_1 ending about opposite one-fourth the length of Rs, Sc_2 just beyond this origin; cell 1st M_2 open by atrophy of m; m-cu shortly before fork of M, a little longer than the distal section of Cu_1.

Abdomen dark brown, the hypopygium a little brighter. Male hypopygium (Plate 2, fig. 35) with the entire mesal face of basistyle, *b*, produced into a cushion that is provided with a double or triple row of long powerful setæ, the caudal end of the cushion further produced caudad as a glabrous obtuse blade. Outer dististyle, *od*, a simple curved spine from a dilated base. Inner dististyle, *id*, with the spine on outer border relatively small. Arms of ædeagus, *a*, long and relatively slender.

Habitat.—New Guinea.

Holotype, male, Sattelberg (Sattelberg), Huon Gulf, September 20–30, 1898 (*Biró*).

The species is dedicated to the memory of Ludwig Biró, former custodian of the Hungarian National Museum. It is most similar to *Toxorhina* (*Ceratocheilus*) *romblonensis* Alexander (Philippines) in the open cell 1st M_2 and nearly erect anterior branch of Rs. All other Oriental and Australasian members of the subgenus so far described have cell 1st M_2 normally closed. The present fly is readily told from *romblonensis* by the lack of a black dorso-longitudinal pleural stripe, the different coloration of the præscutum and abdomen, and the undarkened costal cell. Riedel [19] had earlier examined this specimen and noted its resemblance to *Ceratocheilus* but did not complete the identification.

[19] Ann. Mus. Nat. Hungarici 18 (1921) 135, No. 21, as *Teucholabis* (?) sp.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *od, va*, outer dististyle, ventral aspect; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov., venation.
2. *Dolichopeza* (*Nesopeza*) *subcuneata* sp. nov., venation.
3. *Scamboneura minahasa* sp. nov., venation.
4. *Scamboneura subfaceta* sp. nov., venation.
5. *Macromastix risbeci* sp. nov., venation.
6. *Macromastix caledoniana* sp. nov., venation.
7. *Tipula leucosticta* sp. nov., venation.
8. *Limonia* (*Limonia*) *pacatella* sp. nov., venation.
9. *Limonia* (*Libnotes*) *riedelella* sp. nov., venation.
10. *Limonia* (*Libnotes*) *djampangensis* sp. nov., venation.
11. *Limonia* (*Libnotes*) *mopsa* sp. nov., venation.
12. *Limonia* (*Idioglochina*) *flavalis* sp. nov., venation.
13. *Limonia* (*Alexandriaria*) *cinereicapilla* sp. nov., venation.
14. *Helius* (*Helius*) *subarcuarius* sp. nov., venation.
15. *Limnophila* (*Elæophila*) *marmorea* sp. nov., venation.
16. *Hexatoma* (*Eriocera*) *malangensis* sp. nov., venation.
17. *Hexatoma* (*Eriocera*) *atricornis* sp. nov., venation.
18. *Gynoplistia* (*Gynoplistia*) *biróana* sp. nov., venation.
19. *Trentepohlia* (*Mongoma*) *auricosta* sp. nov., venation.
20. *Trentepohlia* (*Mongoma*) *auranticolor* sp. nov., venation.
21. *Trentepohlia* (*Mongoma*) *separata* sp. nov., venation.
22. *Gonomyia* (*Lipophleps*) *walshæ* sp. nov., venation.
23. *Erioptera* (*Meterioptera*) *sziladyi* sp. nov., venation.
24. *Toxorhina* (*Ceratocheilus*) *birói* sp. nov., venation.

PLATE 2

FIG. 25. *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov., male hypopygium, details.
26. *Dolichopeza* (*Nesopeza*) *insolida* sp. nov., male hypopygium, details.
27. *Dolichopeza* (*Nesopeza*) *subcuneata* sp. nov., male hypopygium, details.
28. *Dolichopeza* (*Nesopeza*) *cuneata* Edwards, male hypopygium, details.
29. *Tipula leucosticta* sp. nov., male hypopygium, details.
30. *Limonia* (*Idioglochina*) *flavalis* sp. nov., male hypopygium.
31. *Helius* (*Helius*) *subarcuarius* sp. nov., male hypopygium.
32. *Limnophila* (*Elæophila*) *marmorea* sp. nov., male hypopygium.
33. *Gynoplistia* (*Gynoplistia*) *biróana* sp. nov., male hypopygium.
34. *Erioptera* (*Meterioptera*) *sziladyi* sp. nov., male hypopygium.
35. *Toxorhina* (*Ceratocheilus*) *birói* sp. nov., male hypopygium.

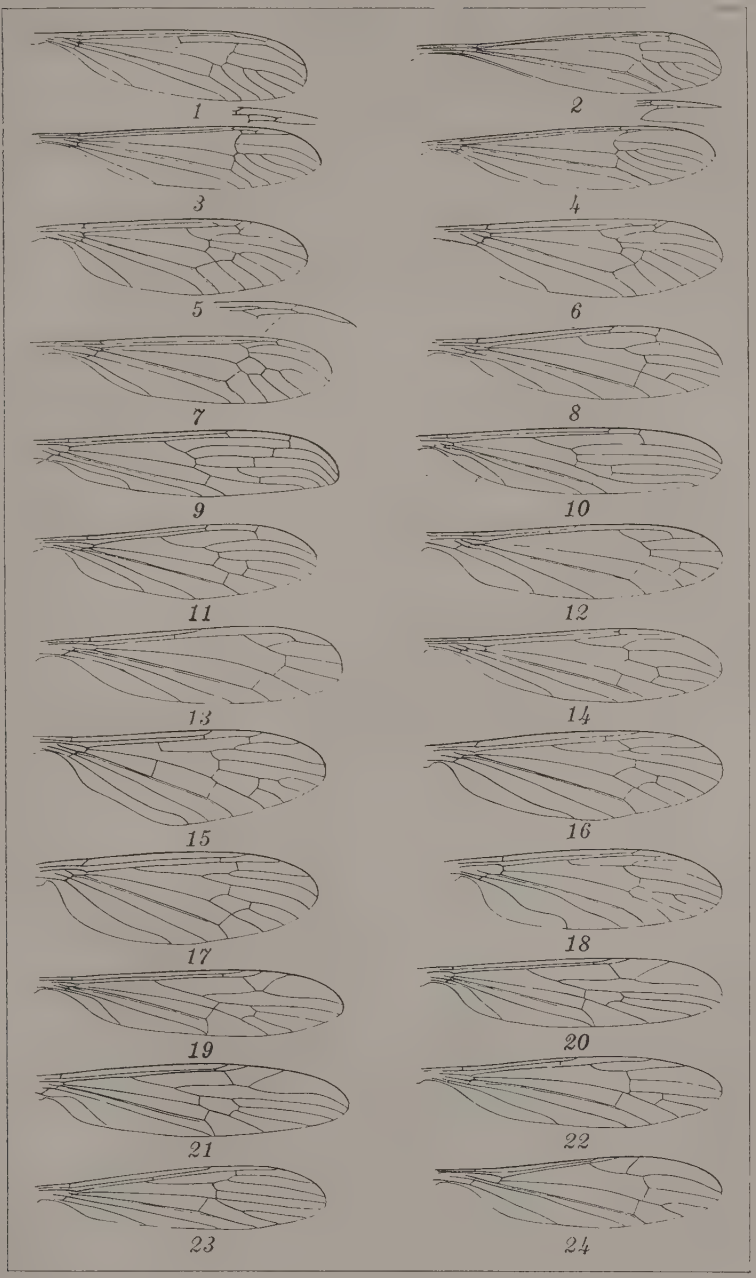

PLATE 1.

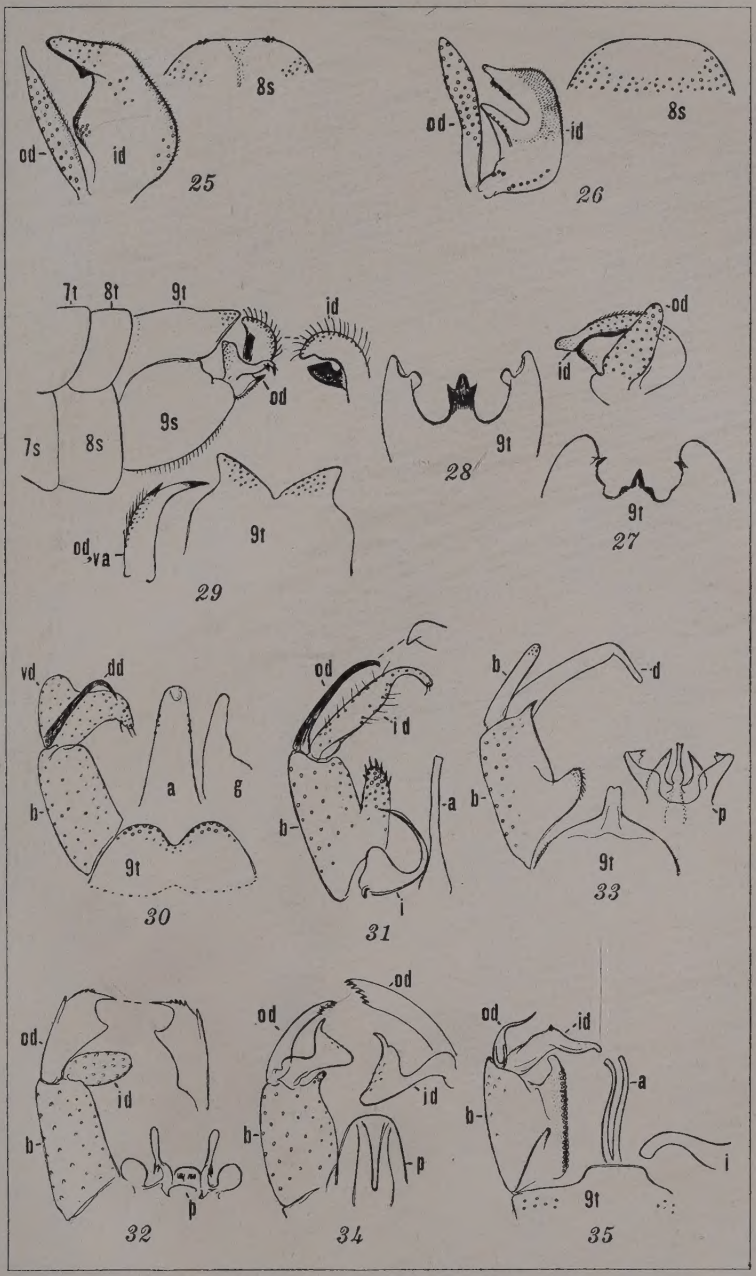
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PLATE 2.